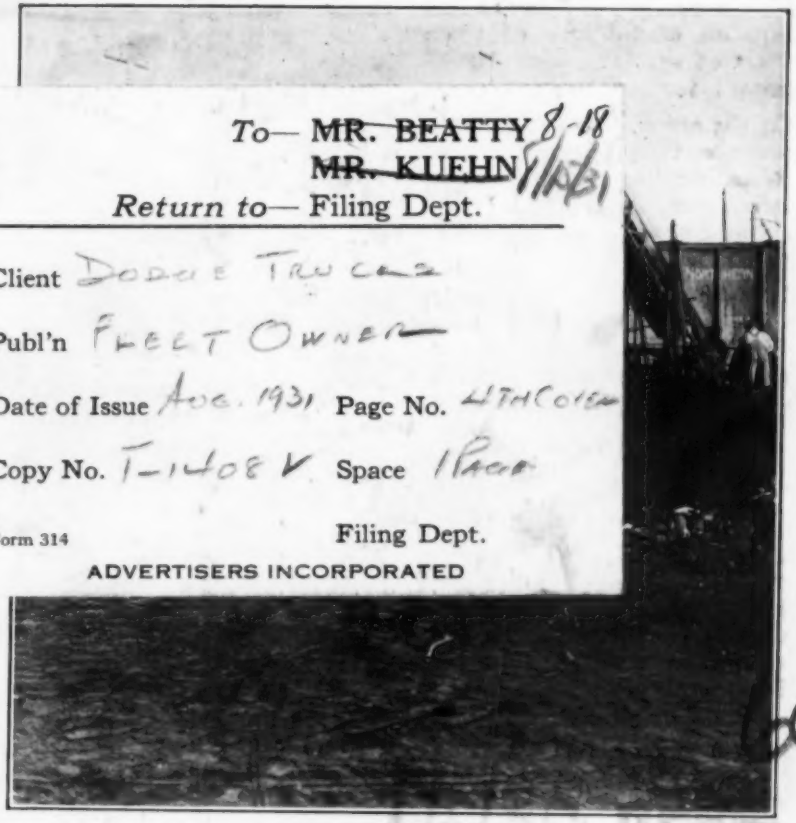
Vol. 7, No. 2 AUGUST, 1931

First Copy

The FLEET OWNER



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Publ'n FLEET OWNER

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A TAXICAB COMPANY TESTS

BRAKE 7 LININGS

A large taxicab company operating over an unusually hilly country put 7 brake linings on test. Three of them were of special material submitted for this test.

Of the seven brake linings one wore out in less than 5500 miles, another needed constant adjustments, while another showed considerable scoring tendencies.

The only stock job that anywhere nearly approached 100% performance was Multibestos LX (Latex Bonded).

Here's the report: "Multibestos LX shows good service. No score on drums and only 1/16" wear at 15,000 to 15,899 miles. *This lining looks excellent.*"

Frankly, this is one of the toughest tests possible for a brake lining. Through heavy traffic—constant "stops" . . . up and down steep grades . . . brakes slammed on and off . . . brake drums reaching "blue hot" temperatures—and Multibestos LX proved "an excellent lining."

Furthermore, this "cushioned stop" brake lining gave increased comfort to the riders. They appreciated the safe, smooth, comfortable stopping that *only* Multibestos LX can give.

Remember—this lining was a standard replacement lining and that "every inch of Multibestos gives the same unequalled performance."

Check up for yourself on this new scientifically developed brake lining. Send for the new booklet—"Multibestos LX Checks the Cause of Costly Readjustments—Heat, Water, Wear."

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There is a Bosch Pyro-Action plug for every engine need and each is more dependable in performance, more economical and longer-lived than any other standard plug.

Bosch Pyro-Action Spark Plugs have a world-wide reputation for fine performance and thousands of users will tell you that Bosch Pyro-Action Plugs have completely eliminated spark plug troubles.

Try a set now—they will last you for years.

At $1.00 each they are the cheapest and best for you to buy.

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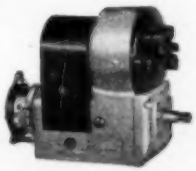

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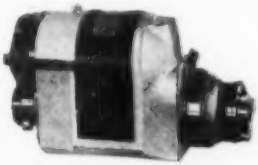

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Super-Energy Magneto

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UNITED AMERICAN BOSCH CORP'N

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DON'T GAMBLE WITH WEATHER

Used EVEREADY

TRACTORS · IMPLEMENTS **MALVESE & CO.** CONTRACTORS' SUPPLIES

New Hyde Park, L.I.

May 5, 1931.

National Carbon Co.,
10 E. 40th St.,
New York City.

Gentlemen:

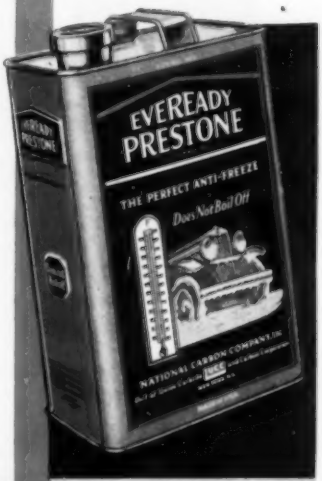
We have used your product, Eveready Prestone Anti-freeze, in our trucks, passenger cars, and tractors for four years now, and can report that its performance each year has been entirely satisfactory to us.

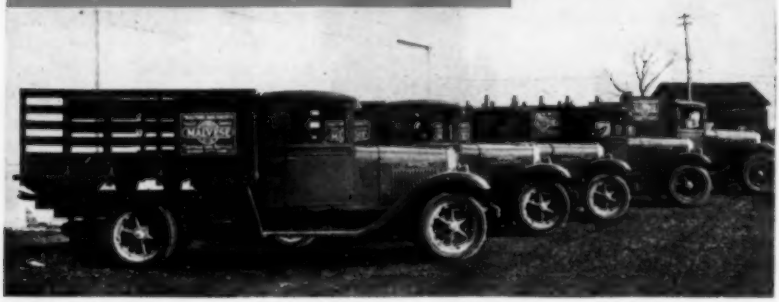
Yours Very truly,
GEORGE MALVESE & CO.,

Mead W. Stone

MWS:ES

CALL MALVESE FIRST





...USE EVEREADY PRESTONE

PRESTONE for 4 years with entire satisfaction

HERE is a New York fleet owner, whose business requires him to work on schedule — often ahead of it — and who has depended on Eveready Prestone for four years to keep his equipment safe from freezing troubles. Used in his trucks, passenger cars and tractors, Eveready Prestone has given four years of perfect satisfaction.

It does not pay to gamble with a makeshift anti-freeze—one that has to be constantly tested and renewed, one that requires constant vigilance for safety. Tie-ups send the overhead soaring, and narrow the margin of profit in any kind of work. This year, fill up with Eveready Prestone and play safe!

This scientific anti-freeze is now improved and perfected. It won't boil off, and it won't freeze. It has less tendency to leak than water. It retards rust and helps prevent clogging in the cooling-system.

Eveready Prestone is a concentrated product. It stays on the job all winter long, requiring no replacement. Figured by the *season*, not by the *gallon*, it is the most economical anti-freeze you can buy!

NATIONAL CARBON CO., INC.
General Offices: New York, N. Y.

Unit of Union Carbide UCC *and Carbon Corporation*

EVEREADY PRESTONE
TRADE MARK REG.

9 POINTS OF SUPERIORITY

1. Gives complete protection.
2. Does not boil off.
3. Positively will not damage cooling-system.
4. Will not heat-up a motor.
5. Circulates freely at the lowest operating temperatures.
6. Will not affect paint, varnish or lacquer finishes.
7. Non-inflammable and odorless.
8. Prevents formation of rust in cooling-system.
9. Economical—one filling lasts all winter.

ONE of a Fleet of three *Continental-powered Brockway vans* operated by the Red Line Transfer & Storage Co. of Pittsburgh, Pa.

"Our three Continental-powered Brockway vans have proven exceedingly satisfactory. Whether on trips west to Chicago or east to the coast, we are never overtaken by trucks going in the same direction. Judging from the way Continental Motors handle the loads on hills—THEY MUST BE GOOD!"

—RED LINE TRANSFER & STORAGE COMPANY

Another achievement for the famous Continental "R" series overhead-valve engines. Built for *long, hard* usage—they always carry a surplus of power and stamina that means extra speed and extra profit per mile. Continental "R" series engines have interchangeable parts—enabling the operator to keep *all* of *his trucks* on the job *all* of the *time*. Continental engines mean power, satisfaction and profits.

CONTINENTAL MOTORS CORPORATION

Offices: Detroit, Mich., U. S. A. - *Factories:* Detroit and Muskegon

Continental Engines

"For Those Who Service Their Own"

The FLEET OWNER

Published Monthly by

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S. P. A. TRUCK CORPORATION
PIERCE-ARROW DIVISION

Another prominent user of SKF *Bearings in the Automotive Industry*

Performance is what the Jobber sells . . . . Performance is what the Truck Owner gets with . . . . SKF Bearings.
COLONIAL SAND & STONE CO.
SERVICE

CERTAIN PERFORMANCE JUSTIFIES USE OF SKF

MILES of satisfactory service are being rolled up by this Pierce-Arrow 8-Ton Truck, Model PZ, in an exacting and rough job. Materials for street paving work must be delivered promptly on scheduled time. SKF Ball Bearings on important locations of the truck share that responsibility.

In the differential and on the worm shaft, SKF Ball Bearings assure quiet, smooth operation. Wear and tear is reduced to a minimum . . . for SKF 's never need adjustments . . . and maintain close tolerances of parts indefinitely. Where dependabilitv is paramount, SKF 's are proving that, "You may buy a bearing as a bargain . . . but try and get a bargain out of using it."

SKF INDUSTRIES, INC., 40 East 34th Street, New York, N. Y.

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SKF

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The FLEET OWNER

"For Those Who Service Their Own"

PUBLISHED monthly in the interests of Automotive Fleet Owners who maintain their own Repair and Service Shops, and devoted to the better operation and maintenance of Trucks, Passenger Cars, Busses and Taxis.

HENRY CLAY FISCHER, EDITOR

Vol 7. New York, August, 1931 No. 2

This Thing Called Procrastination

THE old saying used to be: "Never put off 'til tomorrow, what you can do today." Nowadays, it seems to be "Always put off 'til tomorrow what you can do today, for you may not have to do it tomorrow." At least many individuals are doing just that and the paradoxical part of the situation is that sometimes the modern version of it works—but not to the benefit of the party concerned.

For instance, it is quite possible that you may need some new trucks or other vehicles, depending on your line of business. You have put off buying them during the past year, despite the fact that much of your equipment had long since passed the stage of profitable operation. You may not be aware of it, but during this period your obsolete equipment may have been injuring your business through prohibitive operation and maintenance costs, and, what is equally important, from an advertising standpoint—depreciating the standing of your firm to the man in the street.

It is also quite possible that some of the vehicles in your fleet may need their engines reconditioned—new pistons, pins and

rings, etc. You have put off this work because you didn't want to "spend the money" or for other seemingly legitimate reasons. The thing to bear in mind here is that you are *paying* for these new rings whether you get them or not; paying in terms of high oil consumption; low gasoline mileage; slower operating schedules and frequent road breakdowns—all of which cost money. The same can be applied to brakes that are faulty and their replacement delayed; schedules are slowed up; drivers have less confidence and speeds are held down; accidents are frequent.

They say that he who *needs* something and does not get it, pays for it anyway. This is not *our* advice, but is that of the sages, which has been handed down from generations back. We believe in it. Don't take it, if you so choose. Put off 'til tomorrow what you *must* do today and maybe you won't have to do it tomorrow, because tomorrow you may find yourself no longer in business, all on account of this thing called procrastination. The old adage about its being the "thief of time" cannot be changed.

Continuity, the Keynote

IN late months we have been receiving letters from readers asking whether such-and-such a product is still being manufactured, "because we have not seen it advertised in the automotive publications for the past several months." Nine answers out of ten were to the effect that the manufacturer was still in business but had ceased advertising, "because of the depression."

All of which seems to emphasize the value of *continuity*, the keynote in advertising. If your favorite product has suddenly disappeared from the advertising pages of trade or class publications, it does not always follow that it is no longer being made. Undoubtedly the advertising suspension is but a *temporary* one and (let us give you a little inside tip) you will soon see it back in the fold again. Spasmodic splurges in advertising, as in all things else, have been tried and found wanting and manufacturers are realizing, more and more, that *continuity* is truly the keynote of successful advertising and merchandising.

The Editor

How Our Fleet of 265 Motor Coaches of the Larger Type is Operated and Maintained

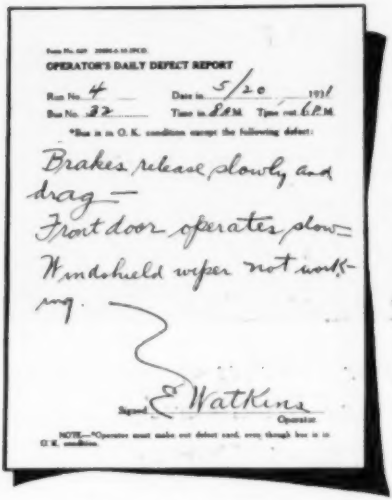
By P. V. C. See*

TO obtain and follow up information on motor fleet maintenance, it is very important to lay out the best form of clerical system so that the information can be secured accurately with the minimum amount of work, both on the part of the garage mechanics (who are very poor clerks) and the clerical force, which must tabulate and make up the various reports. In order that our mechanics will do as little clerical work as possible, various forms have been designed that require the least possible amount of writing. In our opinion, data is of no practical value unless it is summarized in some form of tabulated monthly report.

Our drivers are required to make out a daily report on what is known as Form No. 669. This is shown in Figure 1. This form must be made out, even though the bus may be in o. k. condition. It is made in duplicate, one copy being sent to the superintendent of transportation and one to the superintendent of equipment. In each office is a file cabinet with a space for each motor coach. As the drivers' reports are received, they are filed under the individual motor coach number. In this same pocket are placed the reports of all inspections, which are made on Form No. 670, illustrated in Figure 2.

Road calls are also filed in this same cabinet, they being made out on Form No. 587, shown in Figure 3. Therefore, each of the pigeon holes in the cabinet carries a complete history of the operation of each motorcoach. When in trouble on the road, the driver calls up the transportation dispatcher, who makes out Form No. 587 in duplicate, noting thereon the time he received the call. The shop department then records the time the repair men arrive at the defective

* *Supt. of Equipment, Northern Ohio Power & Light Company, Akron, Ohio.*



OPERATOR'S DAILY DEFECT REPORT

Bus No. 4 Date in 5/20 1931

Bus No. 32 Time in 8 A.M. Time out 6 P.M.

*Bus is in O. K. condition except the following defect:

Brakes release slowly and drag—
Front door operates slow—
Windshield wiper not working.

Signed E. Watkins
Operator

NOTE—*Operator must make out defect card, even though bus is in O.K. condition.

Fig. 1—Drivers' Report

motorcoach and also the time the motorcoach is again put into service. A report of the actual trouble found is also made on this same form.

The foregoing reports are tabulated under 33 headings, in such a form so that when investigations are being made at foremen's meetings (more about which will be related later) we can tell instantly how many road calls any particular motorcoach has had and can refer to the file and get the actual dates of the road calls. This system, therefore, gives us a complete history and follow-up on the road calls and forced-stop situation. The tabulated report of forced stops and road calls is forwarded to the transportation department and other department heads. Cooperation is received from the transportation department in an effort to reduce the number of these calls.

The Inspection Sheet, our Form No. 250, shown in Figure 4, is kept in the inspection-garage offices; each driver's defect report and all road calls are daily tabulated thereon; the gasoline and oil averages are also shown. This sheet is kept in a loose-leaf binder until the date of the next inspection. When the motorcoach comes in for inspection, the sheet is removed and the back of the sheet is used by the inspectors to list the work they have done. Therefore they have all the information as to how the motorcoach has performed since the last inspection. This acts as a very good guide for the inspectors.

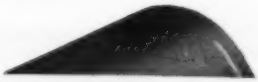
The Shop Repair Order, our Form No. 182, shown in Figure 5, is used whenever the coaches are

BUS No. DATE

Gasoline Gallons	Oil Pints	O. K. By
Motor		
Chassis		
Brakes		
Radiator & Hose		
Body		
Electrical		

Fig. 2—Inspection Sheet

A New



HEAVY DUTY RADIATOR HOSE

5 Points of Superiority

1-Five-ply construction.

2-Specially compounded internal tube withstands heat—corrosion.

3-Heavy fabric cover will not tear or buckle.

4-Will not break down from excessive pressure or vibration.

5-Surface calibrated in inches for cutting correct lengths.

that eliminates frequent replacements

FAILURE of radiator hose on a truck or bus is just as vital as tire failure or motor trouble. All result in loss of time—money—patience.

Miller's new Heavy Duty Radiator Hose will help you keep your equipment in constant service. Built of five separate sturdy plies it gives unusual protection against severe pressure and vibration. A thick rubber tube on the inside is specially compounded to resist hot water, alcohol, and other anti-freeze solutions. The extra heavy fabric covering will not tear or buckle when pressure is applied to the hose clamps.

Get a Free Sample of This Hose

On request we will send a free cross section of Miller *Heavy Duty* Hose for your inspection. Simply write your name and address below—tear out and mail to The Miller Rubber Products Company, Akron, Ohio.

Name_____

Address_____

City_____ State_____

MILLER

Accessories and Repair Materials

Other Miller Accessories for Your Fleet
—A new Heavy Duty fan belt BUILT to give long, enduring service without frequent adjustments. Also high pressure car washing hose, top dressing, friction tape, air hose, heavy duty water hose, gasoline hose and windshield wiper hose.

sent to the main over-haul shop for repairs. This form is made out in duplicate, one copy being kept by the garage so that when the repaired coaches return, the men are able to check up and see if the work they reported has been properly taken care of. The columns showing the number of hours and the work done are only used in cases of accidents or fires, where the cost figures may be required for the adjustment of a claim. At that time the material is entered on the back of the sheet, together with its cost.

Inasmuch as tire work is done on a mileage basis, our Form No. 396, Tire Change Card, shown in Figure 6, is used when tire changes are made. It is often necessary to do this work in rain or snow; therefore a cardboard form is used.

Another Form, No. 751, (not illustrated) is used very extensively for keeping track of mileage on inspections, cleaning, and practically all other classes of work that is done at regular intervals. On this sheet there are spaces for each bus (listed by number) and also 31

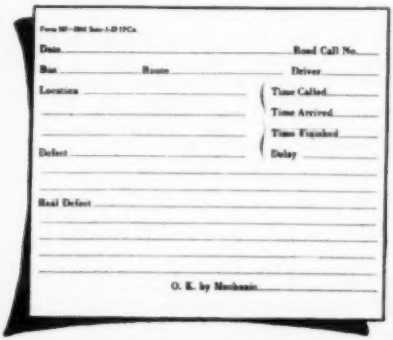


Fig. 3—Road Call Report

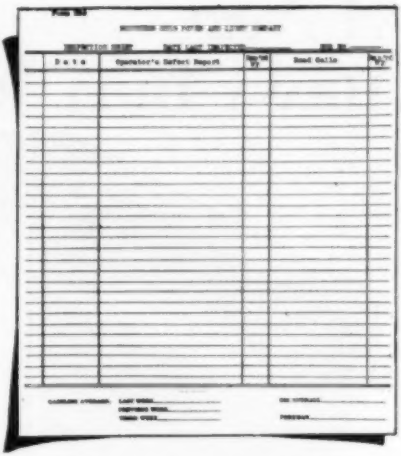


Fig. 4—Inspection Sheet

spaces to represent the days of the month. Each sheet, therefore shows exactly what work has been performed (inspection and cleaning) on each bus, for the respective months.

In the first installment of this article, (see March issue), the system of determining major overhauls was outlined in detail and the average life between overhaulings was given as about 45,000 miles, although some engines have performed well over 100,000 miles. When a motorcoach comes to the overhauling shop, a list is made out on Form No. 182 (shown in Figure 5) the Shop Repair Order, that includes everything that the garage department feels should be done on the motorcoach.

If the engine is reported, the foreman in charge of the engine department looks up the records of the engine, finding when it was last overhauled and how much mileage

The PROPER TIRE...

for a 21-TON LOAD

REGARDLESS of tonnage there is a Goodrich Silvertown that will deliver you the maximum in economical, efficient tire service.

Goodrich engineers have carefully determined, not only on the basis of tonnage, but on the kind of tonnage and the conditions under which it must run, just which type, size and model tire will best meet your individual requirements.

For the job pictured above there is no better tire made than the 9.75-20 Goodrich Heavy Duty Silvertown designed for this particular operation. And so on right down the line.

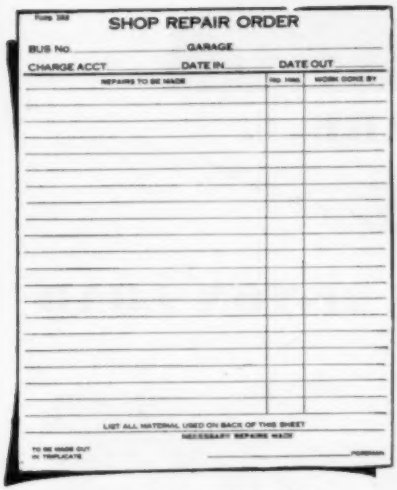
How can you be sure that *your* trucks are riding on the right kind of tires? Phone your nearest Goodrich Distributor. If balloons won't fit your operation, he'll tell you so. If they do, you ought to know about it *now*.

LEARN MORE ABOUT TIRES. Get your copy of the especially prepared Goodrich Booklet which is full of truck tire facts that you can put to immediate use. Tear out this page. Write your name and address on it and mail to the Truck & Bus Tire Department, The B. F. Goodrich Rubber Company, Akron, Ohio.

HEAVY DUTY

Goodrich Silvertowns

When Writing to Advertisers Please Mention THE FLEET OWNER



SHOP REPAIR ORDER

BUS NO. GARAGE

CHARGE ACCT. DATE IN DATE OUT

REPAIRS TO BE MADE | NO. HRS. | WORK DONE BY

LIST ALL MATERIAL USED ON BACK OF THIS SHEET

NECESSARY REPAIRS MADE

Fig. 5—Shop Repair Order

it has made. With this information he is able to determine the probable amount of wear that has occurred in the engine. If he finds that the engine has run over 35,000 miles, he makes no further investigation but removes the engine and substitutes an overhauled one. If the mileage is low, he makes compression tests, removes the head and the pan of the engine, and, if the trouble cannot be located he removes the pistons and checks the entire engine assembly. He may then be able to make repairs without removing the entire engine, thereby saving considerable money.

Much thought has been devoted to the development of an adequate inspection system for the various types of coaches. We have made frequent changes and improvements in the system and at the present time are inspecting on a 1,000 and 2,000-mile basis. The 1,000-mile inspection is a very complete one and includes greasing. The 2,000-mile inspection includes all work done at the 1,000-mile inspection, together with certain additional features.

Lubricating oil is also an important item in motorcoach maintenance. We are using specifications as a guide in purchasing oil, but we feel that as yet there has not been a satisfactory set of specifications drawn up on which oil can be purchased. The first attempt that we made to buy oil strictly on specifications brought in bids for carload lots ranging from 19 to 54 cents per gallon. All of the oil offered would have passed the specifications satisfactorily.

The engine drainings, which are carried to the garage, are dumped into a 1500-gal. tank under the floor of the garage. The pump on one of our oil reclaimers picks the oil up from this tank and pumps it into the reclaiming machines. We have two of these machines and reclaim 100 gal. of oil per day when both are working. The oil is reclaimed for about 12 cents per gal. Aside from being slightly darker in color, it seems to be practically as good as new oil.

The gasoline-service trucks are also equipped with lubricating oil tanks which are heated from the exhaust of the engine in winter. Very accurate records are kept of the consumption of oil in all motorcoaches. These records are tabulated and comparisons are made. When the oil consumption becomes very high on any particular motorcoach, it indicates that the engine requires overhauling.

When our fleet was small, the company sent to outside repair shops a great amount of work, such as magneto, generator, and radiator-

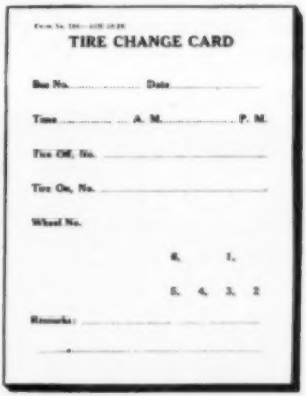
repair work and certain classes of welding; but, as the fleet became larger, we soon found that this work could be done much cheaper and more satisfactorily by our own trained men. We now do all our own generator, magneto, distributor, radiator, and welding work. At present, the only work that we send outside is our spring-repair and heavy storage-battery work. We have battery-charging generators in all our garages, and charge the batteries there unless they need heavy repairs. We believe that we should do all our own spring-repair work, and we probably will do so in the near future.

An economy has been effected by the use of washable wipers. These wipers are purchased in standard size, 18 x 18 in., and issued to the men. Then, by using an exchange system, each man is supplied with all the clean wipers he may require. He is held strictly accountable for the original number of cloths that were furnished him. This not only results in considerable saving in money, but is one of the biggest factors in keeping the garages clean and satisfactory to the insurance company.

A reclaiming department has been developed to inspect parts before they are scrapped. The general foreman passes on whether or not it would pay to repair an individual part.

A check was made on the spark-plug consumption which showed that the average life was less than 5,000 miles. We then put in an exchange system, giving each road mechanic a certain number of spark-plugs and holding him responsible for the number taken out. As he changes spark-plugs in the engines, he brings them to the storeroom for exchange. The old spark plugs are cleaned, adjusted and tested under a 90-lb. air-pressure. This system increased spark-plug mileage well up to 10,000 miles.

When motorcoaches become obsolete they can be used to advantage for service trucks and special pieces of apparatus. It is a very simple matter to cut down the long wheelbase and make whatever changes are necessary. Fig. 7 shows an old White motorcoach being used as a salt-spreader. We have three motorcoaches transformed in this way. A power take-off has been installed on the transmission and this is connected to a three-speed Chevrolet transmission, which in turn is connected through a drive-shaft to a Ford axle mounted vertically in the truck. The upper part of the axle carries a wrought-iron wheel for breaking up the salt, the lower end driving a cone for spreading salt. By the use of the touring-car transmission, any speed can be obtained regardless of the movement of the


TIRE CHANGE CARD

Bus No. ..... Date .....

Time ..... A. M. ..... P. M.

Tire Off, No. .....

Tire On, No. .....

Wheel No.

6. 1.

5. 4. 3. 2

Remarks: .....

Fig. 6—Tire Change Card

truck. A tapered steel box holding about 3 tons of salt is mounted on this truck. There is also a lever arrangement which controls the flow of salt, so that the driver has full control of the distribution.

These three salt-trucks are able to cover the city very quickly after a snow or sleet storm. They salt the points where the motorcoaches have to stop and also all hills. Although Akron is a very hilly city, we have not used a set of chains in the last four years.

The holding of foremen's meetings is one of the methods used to raise the standard of maintenance. Immediately preceding the holding of the monthly foremen's meeting, all the monthly reports are sent to the different foremen so that they may look them over and be able to discuss and explain them in the meeting. The reports consist of:

(1) Road calls and forced stops, figured per motorcoach and per motorcoach mile, and a comparison of the different garages and makes of motorcoaches.

(2) Gasoline and oil consumption of the different makes of motorcoaches.

(3) Labor cost, figured in dollars and man hours.

(4) Cost of the material used in the different garages, and the cost of the different makes of motorcoaches.

(5) Large wall curves of the monthly mileage, revenue, operating and maintenance costs per mile.

(6) Monthly progress report, made on all special work being done on the motorcoaches.

The progress report shows the number of such motorcoaches requiring the work, the number that have been completed, the number done during the last month, and the number yet to do. Discussion brings out why more progress has not been made, and what can be done to push the work forward. In this way we are sure that, when any work is started, it will be completed on all of the motorcoaches.

The discussions at these meetings often bring out improvements in maintenance methods and result in a standardization of the methods of work. At the conclusion of the technical part of this meeting, the head of the accident-prevention de-

(*Please turn to page 64*)

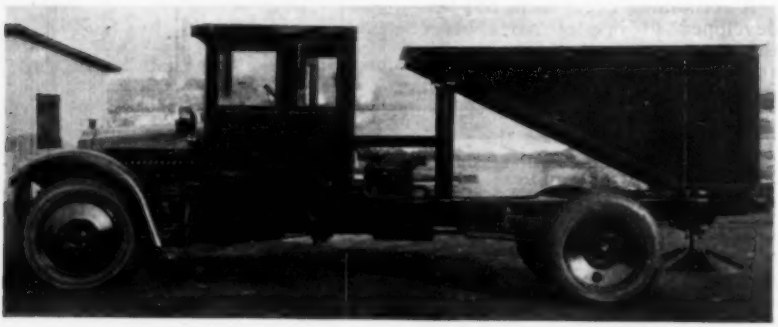


Fig. 7—Obsolete coach chassis used as a salt spreader

50,000 MILES AND NO SIGNS OF WEAR

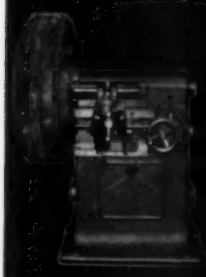
"WE installed Lempco Gun Alloy Brake Drums a year ago; these have been in constant use since and have run approximately 50,000 miles yet show no appreciable signs of wear," says the Green Cab Company, taxicab operators in Cleveland, Ohio..."And these drums have given longer life to brake lining."

Whether you are operating trucks, busses or taxicabs, you will always replace with Lempco Gun Alloys after using one set. For Gun Alloys outlast ordinary drums three to five times... increase brake lining life 200 to 300%, thus eliminating 75% of all brake adjustments as well as three to five brake drum replacement jobs. That means every set of Lempco Gun Alloys reduces maintenance costs by practically $150.00.

Test Gun Alloys for service and braking efficiency against any other drum and, like the Purities Baking Company, Chicago, operators of 2,257 trucks, you will say, "We find Lempco Drums best".

Your parts dealer has Gun Alloys or can get them over night for practically every bus, truck or taxicab in operation.

LEMPCO PRODUCTS, INC., *Bedford, Ohio*
Branch Offices and Warehouses:
NEW YORK *249 W. 64th Street* CHICAGO *323 W. Polk Street* SAN FRANCISCO *1656 California Street*
LOS ANGELES *244 W. 11th Street* ATLANTA *279 Ivy Street* DALLAS *2705 William Streets*
KANSAS CITY *16th & Oak Streets* MINNEAPOLIS *90 South Eleventh St.*



Write also for folder describing the multi-purpose Lempco Drum Lathe. It machines flywheels, resurfaces differential cases and hub flanges as well as reconditions every type and size brake drum.

Co-Ordinating Freight Service

Demountable Truck Body and Freight-Car Container Combination Provides Unique Freight Service

By K. W. Hubbard*

THE development of intercity motor truck transportation has been so extensive in the last decade that the railroads have experienced serious losses on short haul freight traffic of all classifications. Less-than-carload merchandise freight has, in some instances, practically all left the railroads in favor of the highway service.

Generally, the reasons for the greater popularity of the motor truck for shipments of this kind are: direct collection and delivery, flexible service, saving in crating and boxing and reduced risk of loss by theft or damage. Probably the greatest appeal of motor truck service lies in the generally lower rate structure, as compared with rail rates, under which it can operate and return a reasonable profit. Shippers are frequently solicited on the basis of the saving that can be made over common carrier rail rates by use of motor trucks. Truck operators can frequently include pick-up and delivery at each end of the haul without extra expense to the shipper.

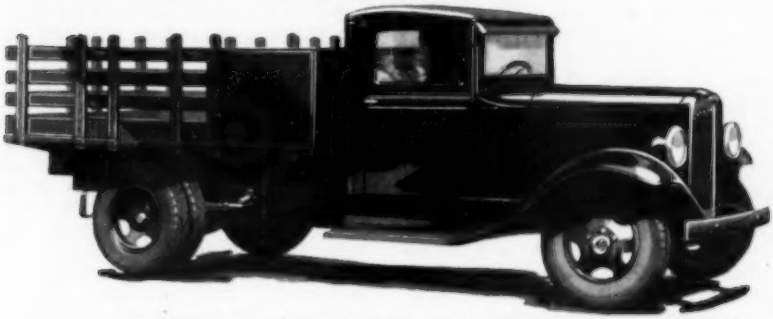
The cost of operating a motor truck is comparatively low for short distances but increases rapidly with increased mileage. Under average conditions the cost of operating a 5-ton truck, if the commodity rates are not to exceed rail charges, will limit its economic radius of operation to approximately 75 miles. Beyond this point it becomes more economical, using rates as the only basis for comparison, to ship by rail.

All railroad car movement is subject to intricate terminal switching and L. C. L. traffic is burdened with considerable platform expense due to the frequent rehandling required at transfer points. It has been estimated that the direct labor cost of handling a ton of L. C. L. freight on station platforms is approximate-

* *President, Cargo Transport, Inc., 127 Tecumseh St., Toledo, Ohio.*

$625 for REO Quality REO Speed REO Economy REO Long Life

Four-Cylinder $625, Six-Cylinder $725
Chassis f. o. b. Lansing, Michigan
DUAL WHEELS EXTRA



THE new Reo SPEED WAGON sweeps aside all previous work-limitations of trucks in the lowest price class. It fulfills ***entirely*** the exacting 1½-ton haulage demands of ***every*** industry.

REO has met the low-price 1½-ton market with the finest truck that sound engineering, extensive factory facilities and ample capital have yet been able to produce. *For comparable quality, size and specifications the new SPEED WAGON is the lowest priced 1½-ton truck in the world!*

REO MOTOR CAR COMPANY, LANSING — TORONTO

THE NEW 1½ TON

REO SPEED WAGON

Extra Size, Extra Strength, Extra Power, with assured lower per-mile cost of operation

4 cylinder engine—5 bearings • 6 cylinder engine—7 bearings • Chrome nickel iron cylinders • Extra large piston displacements • Force feed lubrication • Strong channeled frame—7" deep • Four Speed Transmission • Full floating rear axle • Forged Spoksteel Wheels • Internal hydraulic brakes Two liberal wheelbase lengths More loading space behind cab.

Available with Standard and Special Bodies for Every Haulage Need

ly 60 cents. Under the present system of operation, this type of freight must be rehandled at least once and frequently two, three or four times at intermediate transfer points. When cartage expense at each end of the rail haul is added to rail charges, it is apparent why the highway intercity motor truck, with its minimum burden of one handling at origin and one at destination, can cover a large radius in competition with rail common carriers, despite its higher unit or ton-mile cost of operation.

It is uneconomic for industry to pay more for common carrier rail than highway service in the "short haul" territory in which motor trucks can obviously give a less costly movement than can the railroads, and likewise it is extravagant to utilize a facility like the motor truck for "long haul" service when cheaper rail transportation facilities are available.

Recognizing this situation, an organization known as Cargo Transport, Inc., was formed to give store-door collection and delivery in the cities of Cincinnati, Dayton and Toledo and adjacent towns, using motor trucks for the local service and the Cincinnati and Lake Erie Railroad for the intercity haul.

Between these industrial cities, merchandise traffic has always been heavy; a large volume being automobile or other mechanical units or accessories, either finished or semi-finished, to meet the production demand of manufacturers. Originally such traffic was handled by rail service but the saving in packing and terminal trucking expense, as well as the reduction in necessary inventories which were formerly required to protect the production routine from interruption, has resulted in much of the traffic being diverted from rail to highways. Motor trucks effected overnight delivery in volumes which conformed to daily production demand and at rates which approximated rail rates, less trucking ex-

Unit body being unloaded at off-track station for the rehandling of small-lot shipments

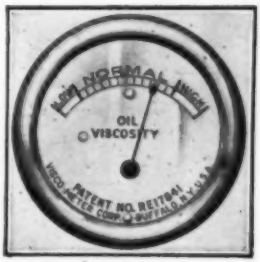
The VISCOMETER

Takes the Guesswork Out of Motor Lubrication

for

Longer Motor Life . . . . Smoother Operation

Greater Economy . . . . . Fewer Repairs



Visco-Meter assures correct lubrication and is the first step toward economical operation. It means minimum engine-wear and consequently, longer engine life. It means better performance and the elimination of costly repair bills.

This is what Visco-Meter accomplishes by providing the operator with a continuous indication of the lubricating value (i. e. viscosity) of the motor oil. At a glance, behavior of the oil under actual operating conditions is revealed! The driver knows instantly before damage occurs.

Visco-Meter also enables you to select the correct S. A. E. viscosity oil for every engine . . . Get all the facts. Send coupon today.

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Visco-Meter Corp., 318 Grote Street, Buffalo, N. Y.

Gentlemen: Please send me full details on Visco-Meter, including the new booklet "A Practical Test for Viscosity."

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THERMOID ENGINEERS

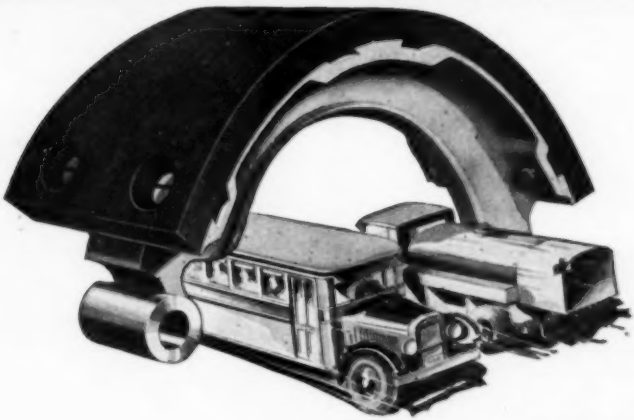
New conditions bring new problems that require new solutions. In the field of heavy motor transport, higher speed, greater capacity and increased traffic brought insistent demands for improved braking material. Short wear raised operating costs per mile and caused frequent, costly tie-up. Uncertain stops meant unfavorable impression and possible accidents. Drum scoring was expensive. Noisy brakes suggested unsafe vehicles. Fade-out constantly annoyed drivers. Thermoid engineers studied these problems . . . analyzed them . . . then they went to work.

Thermoid engineers went to work in the Thermoidexperimental laboratory. They knew that some brake blocks on the market gave long wear but in doing so sacrificed stopability, while others stopped satisfactorily but were short lived. The failure to give satisfactory all-around performance was found to be due to improper balanced characteristics and the fact that these blocks depended on the binder alone to hold them together.

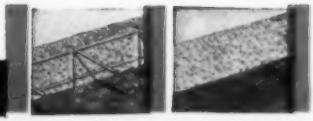
Thermoid engineers overcame these shortcomings in a new block with just the right frictional compound and reinforced it with long fiber asbestos and brass wire. They compressed this material under tremendous pressure and the result is a brake block with greater overall efficiency—not just better in one way, but always.

THERMOID BETTER

COME THROUGH AGAIN



REINFORCED



. . . for the elimination of braking at the bolt holes, cracking and disintegration. Ordinary brake blocks fail because they are only as strong as the binder that holds them together. Due to its reinforcement and balanced characteristics the Thermoid Block withstands the high temperatures and pressures encountered on the road.

The new Thermoid Heavy Duty Brake Block represents as great an advance in braking material as the modern reinforced concrete road does over the old cement road.

GREATER MILEAGE . . . Longer wear due to the equal distribution of the elements in the compound; the reinforcement and the tremendous pressure to which the block is subjected during manufacture. **FEWER ADJUSTMENTS** . . . Rapid wear means frequent adjustment. The Thermoid Block, because of the balanced co-efficient of friction, not only lasts longer but requires fewer adjustments. **PREVENTS DRUM SCORING** . . . The long fiber asbestos and quality brass wire in the Thermoid Block are surrounded with protective elements evenly distributed throughout the compound. **FREEDOM FROM HEAT CHECKING** . . . Ingredients in the Thermoid Compound counteract high heat and dissipate it quickly to prevent heat checking of the drum. **MORE RAPID DECELERATION** . . High speeds demand quicker stops. The Thermoid Block solves this with the right co-efficient of friction. **FREEDOM FROM FADE-OUT** . . . Because it maintains a uniform co-efficient of friction under the varying temperatures. **FREEDOM FROM NOISE** . . . Will not squeal, but is smooth and quiet because of vibration—absorbing elements in the compound.

THERMOID RUBBER COMPANY · TRENTON, NEW JERSEY

BRAKING MATERIALS

penses at each end of the haul.

The group of trucking companies forming Cargo Transport, Inc., uses the equipment resources of the Motor Terminals Company of New York and the combination freight car container and motor truck body, which has been operated by the Cincinnati Motor Terminals Company in handling the interchange of L. C. L. freight between terminals in Cincinnati. The combination truck body and container is carried

tons gross weight, with an addition of one quarter cent for each 500 lbs. up to a maximum of 10 tons. As two of these containers can be placed on a 40-ft. flat car, the minimum tariff to the railroad is 30 cents per mile which compares favorably with the average car revenue of 28 cents per mile.

The Cincinnati and Lake Erie pays the Motor Terminals Company 25 cents per lift for the use of the gantry crane facilities to inter-

Demountable-bodied truck delivering to shipping platform

by both the truckmen and the railroads as a "shipping case." The containers are leased on the basis of $1.00 a day rental for 306 working days per year. The Motor Terminals Company has also erected gantry cranes at the respective rail heads for the transfer of the containers from rail cars to trucks and vice versa.

Under a tariff obtained by the Cincinnati and Lake Erie, the railroad moves the containers at a minimum rate of 15 cents per mile whether empty or loaded up to 7½

change the containers between the cars and the motor trucks, a total for the through movement, of $1.00 per car which is deductible from the gross tariff receipts.

It is estimated that the average cost of operating a heavy duty truck over the highway is about 30c per mile. By shipping the body intercity over rails, the cost is only 15 cents per mile which allows the consolidating company to quote more attractive rates than either its railway or highway competitors.

(*Please turn to page 65*)

THIS KEY

SAVES EVERY TRUCK OWNER REAL MONEY

KEY CONTROL! There, Mr. Truck Owner, is the modern safety measure that greatly reduces maintenance costs for every Klemm Governor equipped truck.

KEY CONTROL! Set the Klemm Governor at the exact speed you want that truck to move. Click! —the turn of that key makes careful driving an automotive operation instead of leaving it up to the driver. *Down* go maintenance costs—*up* go profits.

30 DAY FREE TRIAL

Try the Klemm "Cheat-Proof" Governor for 30 DAYS—FREE. Order from the Klemm distributor in your territory or direct from factory.

Klemm Automotive Products Co.,
1302 N. Halsted St., Chicago, Ill.

FOR ECONOMY
KLEMM *Cheat-Proof* GOVERNOR
FOR SAFETY

Gaskets you can Depend On

Vellumoid is so tough, pliable, and durable, that there is no loss in handling nor in use.

Vellumoid does not dry out or crumble when kept in stock. It is always ready for use.

And when cutting and putting on gaskets, there's no waste, no breakage, tearing or patching.

Whether you use Vellumoid ready-cut gaskets or sheet Vellumoid, you have a gasket which you can absolutely depend on to make tight connections which stay tight.

Ask your Jobber

VELLUMOID
THE REAL REPLACEMENT GASKET MATERIAL

For the Oil, Gasoline, and Water connections

The Vellumoid Co., Worcester, Mass

Servicing *the* Rear End

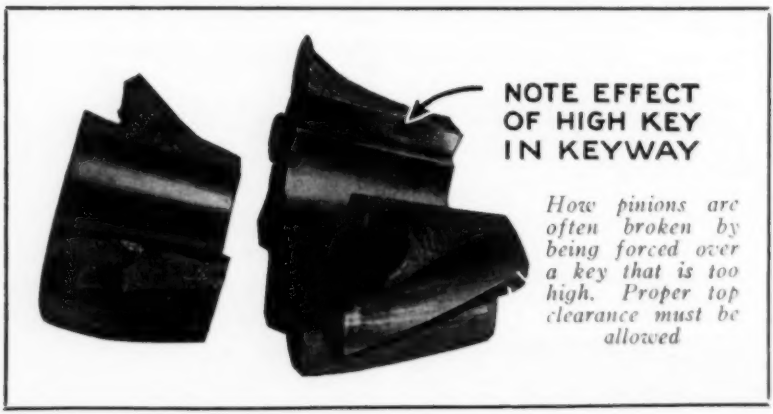
Modern Methods in Servicing Rear Axles and Installing Differential, Ring and Pinion Gears

Second Part

IN the last issue of this publication, the first part of this article discussed the causes of gear breakage, told how to remove the old gears and how to mount the new ones. We left off with the mounting of the pinion on the shaft (where a bored type is used) and pointed out the necessity of a little clearance between the top of the key and the keyway in the pinion. What happens if there is insufficient clearance, is shown in the picture on this page.

We now come to the matter of adjustment, which is perhaps the most important part of the installation, and the place where mechanics usually fall down. Quiet adjustment is something which everyone wants to attain with the minimum of trouble and trials, and if the instructions following are carefully heeded, the job is sure to be a success.

Quiet and durable installations, of course, can only be assured by the proper adjustment in assembly, providing that the gears are accurately cut and mounted. Spiral and straight bevel gears are adjusted exactly alike. While the information in the following paragraphs is particularly applicable to spiral tooth gears, it applies equally to the straight tooth type. The terms used in the illustration on page 30 should first be studied, in order that the directions can be intelligently followed.



How pinions are often broken by being forced over a key that is too high. Proper top clearance must be allowed

The Desired Contact

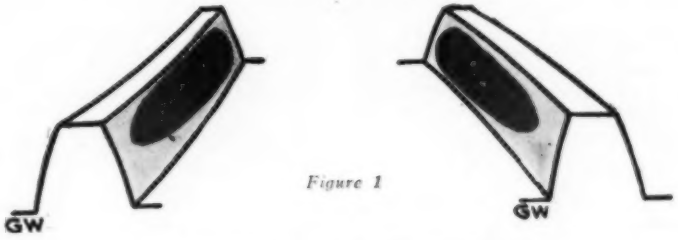


Figure 1

Lengthwise Bearing Adjustments

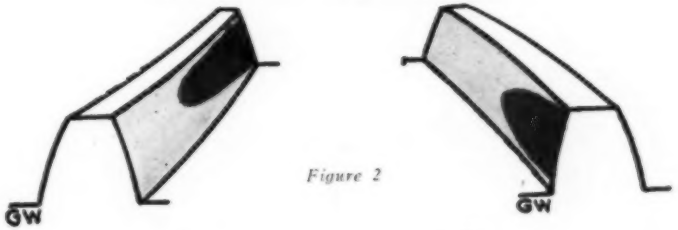


Figure 2

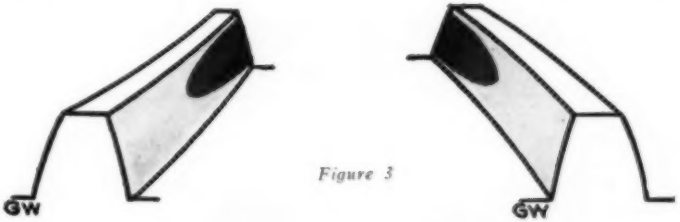


Figure 3

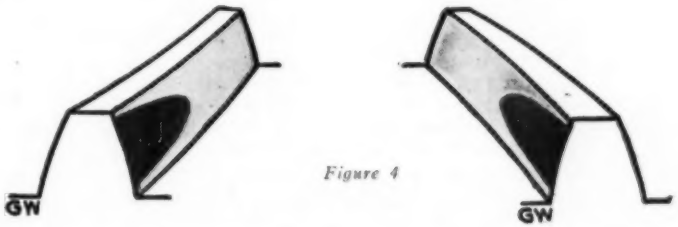


Figure 4

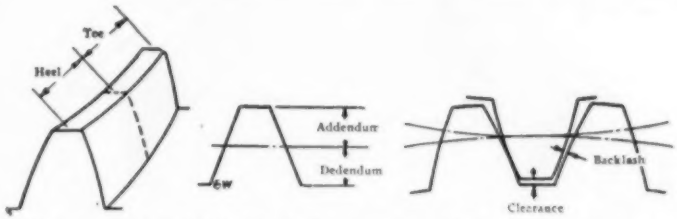
In making gear adjustments there are two things to consider in getting proper tooth contact — first, the lengthwise bearing, which is the bearing along the length of the tooth; and next, the profile bearing, which is the bearing up and down the tooth. The two should be considered separately to get the proper results in combination.

Bevel gears are usually cut to run flush at the large end of the teeth. However, they should be assembled according to instructions, after which very little readjustment will be found necessary. Powdered red lead and any light machine oil should be mixed and spread over the working surfaces of the ring gear teeth with a brush to show clearly the tooth contact obtained.

After mounting the gears with the proper amount of backlash (.006 in. to .010 in. depending on the pitch of the gears—less backlash with a coarse pitch and more backlash with a fine pitch), they should be operated under load in each direction. The rear axle should first be raised to have the wheels clear the floor. Then the motor should be started and the wheels driven in both directions with the brakes lightly applied to obtain the necessary load.

All the illustrations (Figures 1 to 7) show the bearing on the gear tooth. With a right hand spiral bevel gear (mating with a left hand spiral pinion) mounted in a motor car, the driving side is on the convex side of the tooth and the concave side of the tooth is used when in reverse.

It must be borne in mind that the adjustments cited should be moderate and if a great deal of adjustment is needed, the mounting must be carefully checked, and the necessary steps taken to correct the trouble.



The graphic definitions of the terms used in setting forth the proper procedure when mounting and adjusting the ring gear and pinion

The tooth bearing, both lengthwise and profile, should appear as shown in Figure 1—but a condition of tooth contact may be obtained as indicated in Figures 2 to 7.

Figure 2 shows what is called a *cross bearing*—caused by a misalignment of the mounting. The mounting should be tested and, if found faulty, should be corrected.

If the drive has a toe bearing and a reverse heel bearing, the

Profile Bearing Adjustments

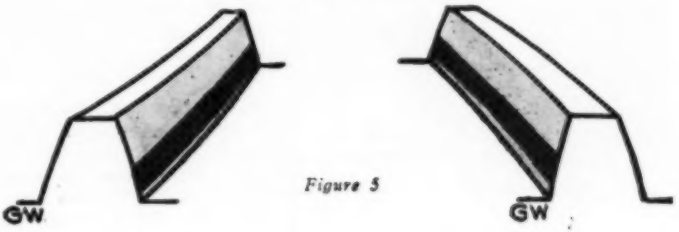


Figure 5

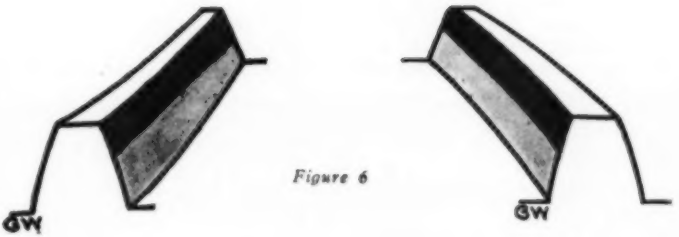


Figure 6

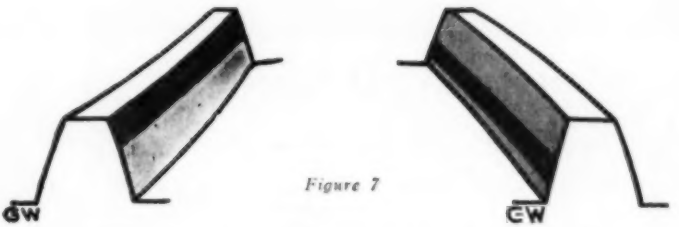
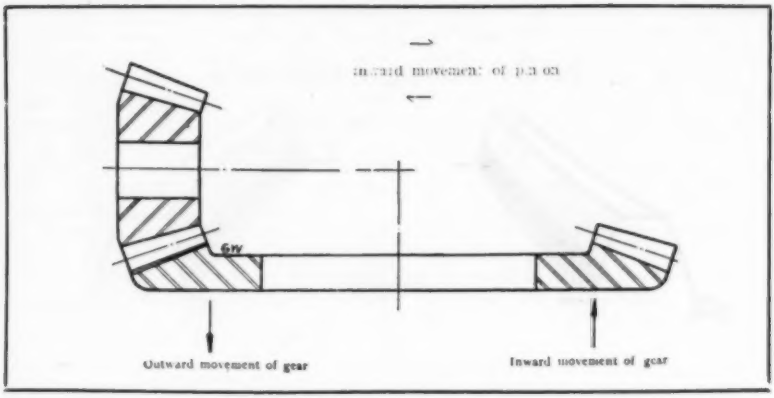


Figure 7

Note: The above tooth-contacts are all incorrect. The ideal tooth-contact is illustrated in Figure 1 at top of preceding page.



gears are serviceable provided the bearing is about 5/8 of the length of the tooth. If the heel bearing occurs on the drive side, it should not be used.

Figure 3 shows a *toe bearing* on each side of the tooth. The gear must be moved *away from* the pinion to increase the lengthwise bearing, which, on ratios of 1:1 to approximately 4:1, will change the profile bearing to some extent and an adjustment of the pinion may be required as described under "Profile Bearing."

Figure 4 shows a *heel bearing* on both sides. The gear must be adjusted *towards* the pinion to increase the lengthwise bearing, which, on ratios of 1:1, to approximately 4:1, will change the profile bearing to some extent and an adjustment of the pinion may be required as described under the "Profile Bearing."

Figure 5 shows a low bearing on the gear tooth which may appear at any position along the tooth. The pinion should be *moved away* from the center of the gear (in the direction of the motor) and, on ratios of 1:1 to approximately 4:1, the gear should be moved towards the pinion to maintain the proper backlash.

This movement of the gear will alter the lengthwise bearing, and several adjustments for both lengthwise and profile bearing may be required to obtain the proper tooth bearing.

Figure 6 shows a *high bearing* on the gear tooth which may appear at any position along the tooth. The pinion should be moved *towards* the gear, and, on ratios of 1:1 to approximately 4:1, the gear should be moved away from the pinion to maintain the backlash.

This movement of the gear will alter the lengthwise bearing, and several adjustments for both lengthwise and profile bearing may be required to obtain the proper tooth bearing.

Figure 7 shows a *lame bearing.* It is possible to adjust the gears and obtain a fair driving condition as indicated in Figure 1, but a poor

(Please turn to page 65)

WANTED!

¶ On page 35 is a form, ready to be filled out. Maintenance men are urged to cooperate in joining this new form of "club."

¶ In order to become a "member" it is simply necessary to participate in these questions and answers, only when you choose to do so, of course, there is *no* fee, *no* dues, and no limitations.

¶ We would like to see every reader join. See pages 34-35.

The Editor

REVIVE THE FLEET!

with

B-N Pins

DALL Pistons

Service Parts

that can be installed at minimum cost.

BURGESS-NORTON MFG. CO.
Geneva, Ill.

DALL MOTOR PARTS CO.
Cleveland, Ohio

K-D

The Model "A" of Valve Spring Lifters Designed for the New Ford

In shops where K-D No. 307 is used the men think of it almost as part of the new Ford. It fits so well. It's so handy and necessary.

No. 307

K-D Mfg. Company Lancaster, Pa.
Canadian Factory: 771 Cannon St., East, Hamilton, Ont.

A Few of the Many Answers to Question No. 11

"Oil for our fleet is used according to the manufacturer of the vehicle and then by the service it renders as the motors get older. On our trucks the oil is changed weekly; on the passenger cars every 500 miles. We would lengthen the period between changes if we were sure of the lubricating quality. Various conditions, too numerous to mention, are responsible for differences in oil consumption, engine temperatures, etc. Would like to get details on how to test crankcase oil without removing from engine."—*W. L. Wood, Mgr. Motor Vehicle Division, West Chicago Park Commission, Chicago, Ill., operating a fleet of 29 trucks, 10 tractors, 26 passenger cars and 36 motorcycles.*

"We have no set basis for changing crankcase oil. This depends entirely upon the condition of the oil, its color and the amount of crankcase dilution that is determinable. We would lengthen the period between oil changes if we were sure of its being further fit for use. The type and condition of the motor is what we go by when selecting oil. The type of driver is also responsible for differences in the condition of the oil after it has been used for some time. Please send us the book that tells how to test oil in the crankcase of the motor."—*Allen Welch, Maintenance Engineer, Davidson Baking Co., Portland, Ore., operating a fleet of 40 trucks and 6 passenger cars.*

"The recommendations of the oil companies are followed in choosing oil for our fleet. We drain crankcases every 500 miles. Engine and piston wear are responsible for differences in oil consumption, temperatures, etc. Please send us a copy of the book showing how to test crankcase oil while the engine is running."—*H. A. Boone, Garage Foreman, Southern Bell Tel. & Tel. Co., Atlanta, Ga., operating a fleet of 20 trucks and 70 passenger cars.*

"Every Sunday morning is inspection time, when engines are tested for knocks, looseness, etc. At that time the mileage is checked and oil is changed where that vehicle has done between 450 and 500 miles. In arriving at the 500-mile basis we made a survey over a period of five months during the peak or heavy season of our business. We ran tests on 500 and 1,000-mile runs, using the entire fleet to get a uniform test. By checking the oil for viscosity and dirt, we found that by using the 500-mile basis, minor motor repairs were 40% less than by changing oil every 750 or 1,000 miles. Since that time we have lengthened the period between overhauls from about 17,000 miles to 28,000 miles. Each time the oil is changed the trucks are also greased. If we were sure of the lubricating quality we would lengthen the period between oil changes. Please send us information on testing crankcase oil while the engine is running."—*W. O. Bingham, Manager, Excello Ice Cream Co., Chickasha, Okla., operating a fleet of 12 trucks and 5 passenger cars.*

Question No. 13 is Important — Please Cooperate!

(Please tear out and mail to The Editor, The Fleet Owner, 90 West St., New York)

Question-of-the-Month-Club

Question No. 13—Fan Belts

How long do fan belts last? (Please indicate below.)
Years? ..... Months? ..... Miles? .....

What is the most common cause of fan belt failure?
Breaking? ..... Chafing of cover? ..... Excessive Stretch? .....

Are frequent inspection and adjustment necessary to secure long life from fan belts in your fleet? .....

If so, how often are these adjustments made? .....

Which type of fan belt do you find most satisfactory? (Please check below) .....
Leather? ..... Fabric-covered? ..... Moulded Rubber? .....

Do you standardize on one type of fan belt wherever possible? .....

Please state the make or type used .....

From your experience, what suggestions can you offer to prolong the life of fan belts? .....
.....

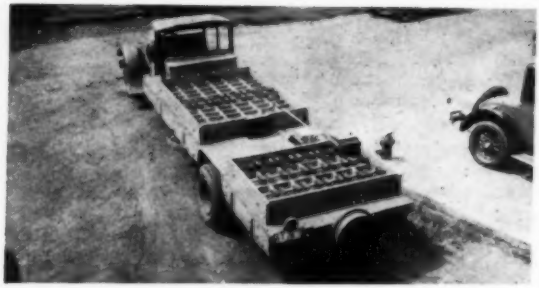
Special Remarks .....
.....
.....

Shall we send you a free catalog on fan belts? .....

How many vehicles in your fleet?
.....Trucks; .....Busses; .....Pass. Cars; .....Other types.

Name of Firm .....
Address .....
City and State .....
Your Name .....Position .....

(Please tear out and mail to The Editor, The Fleet Owner, 90 West St., New York)



Road *Impact* Determined

Motor Bus Shock and Drop Impacts on Highways Measured by U. S. Government Engineers

WHEN the wheel of a motor vehicle passes over an obstruction or a rough place in the surface of a highway, there are two impacts of the wheel upon the road—Shock impact when the wheel comes in contact with the obstruction and drop impact when it hits the pavement following the bounce.

The trend to-day is toward higher vehicular speeds, particularly with the heavier wheel loads, such as in motor bus operation and the Bureau of Public Roads, U. S. Department of Agriculture, has studied the impact forces produced by the rear wheels of a modern bus operating on a concrete pavement at various speeds up to 55 miles an hour and over two types of road obstructions. The studies have included various wheel loads, sizes of tires, inflation pressures, rim dimensions and rim widths. The Rubber Manufacturers Association and the Society of Automotive Engineers cooperated in the investigations.

The operation of heavy vehicles at high speeds has been made practical by the comparatively recent use of high-pressure tires and balloon tires on heavy trucks and busses, says the bureau.

The tests revealed that the impact varies in almost direct proportion with tire inflation pressure. The variation of impact with speed proved to be different for the two types of impacts, drop and shock. The drop impact reached a maximum value at comparatively low speeds and decreased at higher speeds. The shock impact varied almost directly with speed, but did not attain a value as great as the maximum drop impact until a very high speed had been reached. The relations of the various factors in detail are described in the April issue of Public Roads.

These bus impact tests are the latest of a series of impact investigations which the bureau has been

(Please turn to page 66)

Truck Warranty Revised

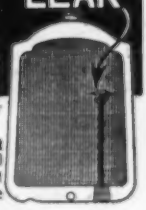
TO aid in a better interpretation of the warranty on trucks, revisions of the standard form were authorized at the spring meeting of the Motor Truck Committee of the National Automobile Chamber of Commerce in New York, recently.

The new warranty agreement provides that, "hereafter service on motor trucks shall be confined to ninety days after the vehicle is delivered to the original purchaser, or prior to the time when the vehicle has been operated 5000 miles, whichever event shall first occur."

The Committee heard reports from many sections of the country, indicating widespread opposition among manufacturers, farmers, retailers and other shippers to the railroad program to equalize competition between highway and railway transportation, through the passage of laws designed to increase the cost of truck and bus transportation.

A. J. Brosseau, President of Mack Trucks, Inc., as Chairman presided at the full meeting of the Committee. Others in attendance included: T. R. Dahl (White); Paul W. Seiler (General Motors Truck); R. G. Hayssen (Sterling); W. C. McAfee (International Harvester); W. S. Graves and J. D. Burke (Dodge Brothers); Robert P. Page, Jr. (Autocar); M. L. Pulcher (Federal); D. C. Fenner (Mack); Edward F. Loomis, Secretary.

STOP THAT LEAK WITH SMOOTH-ON No. 1



YOU can apply Smooth-On with radiator full or empty, hot or cold, without removal from the car and without putting anything inside that clogs the circulation.

Merely roll the Smooth-On into a stiff putty, press it against and into the leak with your thumb or pack it into the defect with a knife blade or screw-driver, and scrape off the excess. The leak will stop instantly and the repair is permanent.

Write for FREE BOOK

Cracked Water Jackets

Water jackets of automobiles, stationary or marine gas engines which have developed long or short cracks or have even had pieces broken entirely out from freezing can be made thoroughly and lastingly serviceable by similar repair, or by applying Smooth-On under straps or a plate.

Get Smooth-On No. 1 in 7 oz.; 1-lb. or 5-lb. tins at any hardware store or if necessary direct from us.

Free Booklet

tells how to stop gas leaks from the tank, gasoline lines and exhaust system, oil leaks at gaskets and at cracks in crank or gear case. It also tells how to make headlight posts, nuts, hub caps and belts and grease cups stay tight, etc.

Mail coupon for a copy

Do it with SMOOTH-ON

SMOOTH-ON MFG. CO., Dept. 71,
574 Communipaw Ave., Jersey City, N. J.
Please send the free Smooth-On Repair Book.
Name .....
Address .....
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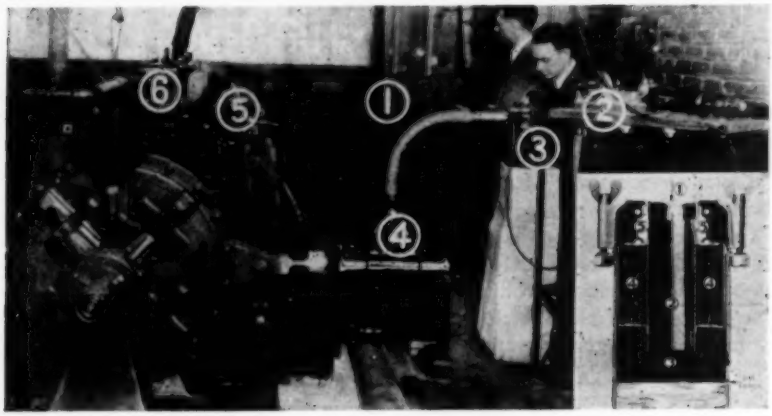


Facts about Air Cleaners

Oil-Reservoir Type of Air Cleaner Proves Efficient in Joint Test Made by Two Manufacturers

EVERY piece of equipment powered with a gasoline engine, whether it be truck, tractor, agricultural or industrial machine, is faced with the problem of overcoming the harmful effects of excessive dust conditions, either in the shape of ordinary road dust or that which is present in quarries and the like, or during building operations. Under certain dusty conditions it is possible for an engine to be literally worn out in a week's operation, and to meet the problem, a highly efficient air-cleaner is essential.

Road dust, for instance, when examined under the microscope, discloses a structure of very sharp and glassy-looking crystals which, upon analysis, are found to be mainly quartz and capable of scratching the hardest steel surface.

Ordinarily, the actual character of dust on the road is about the same throughout the entire country, and the reason that engines wear faster in certain districts than in others is not necessarily because the dust in one district is more harmful; but rather that the engines are subjected to a greater amount of it.

Dust, in reality, is solid matter in a finely divided state. Individual particles of dust float in the air and settle very slowly under ordinary conditions by the action of gravity. Air disturbances tend to keep the dust particles in suspension for lengthy periods, and the rate of fall in still air depends on the size and weight of the particle.

Certain fine dust falls at the rate of less than an inch per hour. The dust generally encountered on roads is nothing more or less than small fragments of crushed rock.

In tests conducted by the Continental Motors Corporation and the A. C. Spark Plug Company engineers, with the oil-reservoir type of air cleaner, some very interesting conditions were found, in which the air cleaner was said to function as efficiently as 99 per cent.

As is the practice of the Continental Motors Corporation, thorough tests are made of all the engine models and also of any accessory or equipment product used in the various and diverse fields where motive power is required. The actual operating conditions, as far as possible, were reproduced in these tests. The photograph accompanying this article shows the set-up that was used. In the present instance, the test covered a period of several months, during which time an ingenious dust-accumulating machine was employed to load the air going to the carburetor with various kinds of dust and dirt found in the several districts of the country, and under the various conditions where engines would be normally required to operate.

The conclusions reached as a result of this test, were that the oil-reservoir type of air cleaner is best suited for this service; the test showed that it effectively prevented wear in those portions of the engine ordinarily affected by dust conditions.

In this type of cleaner, the oil-wetted copper mesh has been so designed that when all of the oil in the oil-chamber has been used up, the dust which will then accumulate on the upper mesh will cause a very sudden increase in restriction, or a very sudden drop in air-flow to the carburetor. This plugging is a particular feature, because the operator will be immediately warned by a sudden change in performance of the engine, and the only way this performance can be brought back to normal is to clean the air-cleaner. This feature eliminates any danger of neglecting to service the cleaner.

The cleaning is a simple matter and is quickly done. By loosening two winged studs, both the oil chamber and mesh cylinders can be removed and cleaned in kerosene or gasoline. The oil chamber is then refilled to the indicated level with fresh crankcase oil. At the same time the copper mesh should be re-oiled. Upon reassembly this air-cleaner is again in the same operating condition as when new.

The purpose of the test just described was to determine that type of air-cleaner which could be safely recommended to operators of Continental engines. The care with which the test was conducted is in line with the practice of the Continental organization, to thoroughly test every engine and every device used in connection with it, before offering new models to the market. This publication is happy to pass this information on to the fleet service industry, for whatever value it may have.

The picture at the top of the preceding page shows (1) Air-flow meter which measures cubic feet per minute of air going through cleaner to engine; (2) Dust feeding machine; (3) Air cleaner under test; (4) Absolute air filter catches any dust not caught by cleaner; (5) Carburetor; (6) Engine; Insert shows cut-away of air cleaner.

and Now, the Smoke Ejector

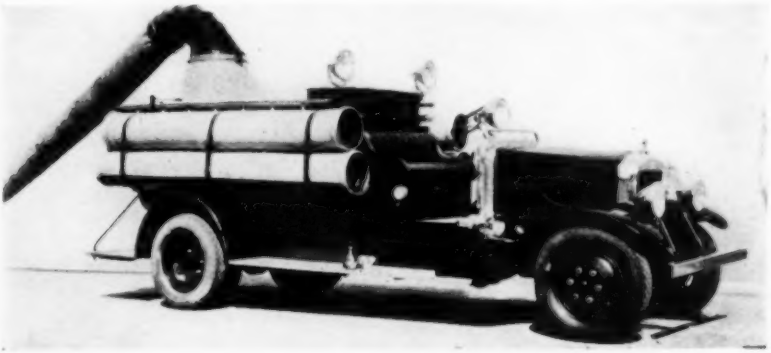
Efficiency of New Development in Fire-Fighting Equipment is Proven in Tunnel Fire at Chicago

PETER PIRSCH and Sons Co. of Kenosha, Wisc., who have long been manufacturers of fire apparatus equipped with engines manufactured by Continental Motors Corporation, have just developed a new and extremely valuable piece of fire fighting equipment known as a Smoke Ejector. The opportunity to demonstrate its efficacy suddenly arose in connection with the recent tunnel fire in Chicago, in which eleven lives were lost.

It will be remembered that sixteen men who were also trapped in the tunnel by a pall of smoke and gas in the course of the fire, were safely brought to the surface after the deadly fumes had been drawn out of the excavation.

The Smoke Ejector has been in process of development by Mr. Pirsch for a number of months. The Fire Department at Chicago sent a hurry-up call for the device at two o'clock on the morning of Tuesday, April 14. At the moment, the Ejector was not entirely completed and assembled. Mr. Pirsch promptly called several of his workmen to his plant and, taking a Continental Red Seal engine out of his stock, hurriedly assembled it into the Smoke Ejector chassis, installing carburetor, distributor, wheels, tires, etc. in the remarkable time of 3 hours and 45 minutes. The machine then made the trip to Chicago, a matter of 52 miles, in 88 minutes.

Just 14 minutes after it started to draw smoke, gas, and fumes from the shaft, the men who had been trapped at the far end of the tunnel started to come out through the elevator shaft. They had spent more than 14 hours behind a wall of gas, fire, and smoke so hot that it melted the rubber clothing and



burned the air hose of a diver sent down to rescue them.

It is remarkable to note that this is the first time that the machine and its motor had been operated, and it stands as a record for the equipment itself and the men who designed and built it. Chief Fire Marshal M. J. Corrigan of the Chicago Department gives it full credit for saving the lives of the 16 men imprisoned in the tunnel.

Peter Pirsch & Sons Company have been consistent users of several types and sizes of Continental Motors Corporation Red Seal Engines in the fire apparatus they produce, and it is significant to note that this new piece of equipment, with its motor hardly assembled, made such a fast trip to Chicago, and then pumped continuously for 6 hours immediately upon its arrival at the fire.

Continuous Base Rims

TO meet the present-day requirements of the balloon tire and heavy duty service, Firestone Steel Products Company, Akron, Ohio, recently introduced the type "R" rim, which, like other types of Firestone rims for dual mounting, is of the continuous base construction and made in one piece. The locking ring, which is riveted to a continuous side ring, is easily removed and always visible.

This new rim has many entirely new features, yet it is interchangeable on the same wheels with other types, since the standardized 28-degree mounting bevel has not been altered. It has been adopted by many truck and bus manufacturers as standard equipment.

The Firestone Company points out that trucks now equipped with solid tires or single pneumatics can be changed over to Firestone continuous base rims with a standardized 28-degree bevel, by either cutting down the wheel and applying Firestone Universal D-6 bands, or by using new disc or cast wheels. All rims of this new type operate the same, either on a disc or cast type of wheel.

All Firestone rims designed for dual mounting have the standardized 28-degree mounting bevel.

In this connection the new booklet "Changeovers Made Easy" just issued by The Firestone Steel Products Co., Akron, Ohio, will be found of great interest. For your free copy of this helpful little book, write to the Company. If you prefer, the Editor will be glad to see that you get a free copy. Just drop us a line.

Cutting Truck Operating Costs

MATERIAL reductions in truck operating costs can be effected through training of drivers in courtesy and safety, H. R. Cobleigh, of the Motor Truck Department of the National Automobile Chamber of Commerce, declared at the annual convention of the New England Coal Dealers Association in Swampscott, Massachusetts, recently.

Lower overhead and insurance premiums and greater customer and public good-will were mentioned by Mr. Cobleigh as the "dividends" which a fleet operator might expect to derive from the safer and more courteous operation of his vehicles.

He also advocated that truck owners provide some incentive in the form of a bonus plan to win the cooperation of their employees. Mr. Cobleigh also spoke on the same subject at a meeting of the Springfield Motor Transport Council.

Facts About Lubricating OILS --- *for Your Notebook*

LUBRICATING oils and their suitability for internal combustion engines was the subject discussed at a recent meeting of the Northwest Section of the Society of Automotive Engineers by Prof. F. C. Baender of the Oregon Agricultural College.

To lay the foundation for better understanding of the suitability of petroleum lubricating oils to the requirements of internal-combustion engines, the speaker first described the methods of extracting them from the crudes, dividing the refined products as marketed into (*a*) paraffin-base oils, (*b*) asphalt-base oils, and (*c*) mixed-base oils.

He next dealt with the properties of the refined oils and the various tests applied to measure the different properties, particularly viscosity. This, he said, usually is determined at two temperatures, 100 and 210 deg. Fahr. As users of internal-combustion engines are not interested in the lubricating quality of an oil at the former temperature, an oil that shows good viscosity at 100 deg. may be a complete failure as a lubricant for an engine operating at 210 deg. or more. A blended oil may show correct viscosity at the lower temperature but when tested at the higher temperature its shortcomings will be apparent, as it will be thinned down to such an extent that it will have lost its lubricating value for the engine.

Viscosity Needed at 210 Deg. Fahr.

OILS suitable for internal-combustion engines as used in automobiles in the summer, said Professor Baender, have viscosity values of 450 to 500 Saybolt sec. at 100 deg. Fahr. and 68 to 72 sec. at 210 deg. For winter use a lighter oil would be more suitable. An ordinary mineral oil of 750 Saybolt sec. at 100 deg. Fahr. possesses a viscosity of about 70 sec. at 210 deg. but a patent has been issued in Germany covering a process for making an oil of high viscosity at the higher temperature. This oil is called Votol. It is made by subjecting a light, clean mineral oil to

the action of a glow discharge of a relatively high-frequency electric current, which seems to produce no other chemical effect except to greatly increase the viscosity, which goes to 240 sec. at 210 deg. The oil thus treated seems to possess lubricating qualities superior to even those of a high-grade mineral-castor oil.

Professor Baender next discussed what happens to the oil in an engine, such as carbonization on the under side of overheated pistons, contamination by dust and metal particles, dilution by unburned heavy ends of the fuel and the formation of sludge. It is a curious fact, he said, that it is impossible to burn oil that is against the cylinder-wall provided the water-jacket is filled with water; experimental evidence is available that proves that the oil-film layer next to the cylinder-wall, which is about 1/40 in. thick, is at approximately the temperature of the water. Hence any oil that has fire and flash-points around 400 deg. Fahr. should be immune from cracking and burning.

Restored Oil Better than New

THE speaker showed himself in agreement with other investigators when he stated that, if the contaminations are entirely removed from crankcase drainings and the remaining oil is properly treated to restore the viscosity, fire and flash-points, freedom from acidity and carbon residue, and so on, the resulting restored oil will be an even more perfect lubricant than new oil. The reason, he said, is that it will be free from molecules that crack against the hot pistons, and also the unsaturated hydrocarbons.

No refining company, he said, can refine an oil as perfectly as can an engine, and we can well say that a properly reclaimed oil is, in reality, a super-refined oil. A rather interesting fact is that reclaimed oil has a higher viscosity at 210 deg. Fahr. than the original oil had, even though both may have the same at 100 deg. The speaker declared that, to be properly reclaimed, an oil must have restored to it every property it had when new, both physical and chemical.

Disagreement was expressed with the theory that, because crankcase oil reaches stable dilution after about 200 miles of operation, amounting to 10 to 15 per cent in the summer and 25 to 40 per cent in winter operation, it is better to use a prediluted oil and eliminate danger of under-lubrication with a heavy oil that will not flow readily when starting a cold engine.

Properly reclaimed oil is declared to be better than new oil. There are many machines now available for oil reclaiming. One of the smaller models is illustrated. This has a capacity of eight gallons per day.

A Course *in* Automotive Ignition

By M. Mallory.

President, Mallory Electric Corporation

Article XXIII—Circuit Breaker Design

THE proper engine timing depends largely upon the design of the circuit breaker and cam, and although the design of circuit breaker levers and cams has been generally given little thought by service men and a good many engineers, lack of improvement in these two units perhaps more than anything else has retarded the development of satisfactory ignition.

The life of the contact points depends perhaps more on the design of the cam and circuit breaker lever than that of any other part of the ignition system. To clearly understand and realize what a difficult problem it has been to design a cam and circuit breaker lever to give satisfactory results, the illustrations accompanying this article should be studied. It must be kept in mind that when the contact is closed, the coil becomes saturated, or builds up its power to produce a hot spark.

Fig. 1 is a typical arrangement, but offers some disadvantages because this arrangement does not permit the circuit or contact points to be closed long enough to completely saturate or build up the coil at high engine speeds. Another disadvantage in this arrangement is that, to obtain a contact pressure of 16 or 18 oz., the rubbing block pressure against the cam must be almost twice as much as the contact pressure. This is due to the two-to-one ratio, that is, the cam lifts the rubbing block .010 while the contact points separate .020. Another disadvantage of this arrangement is that it is necessary to use a very thin rubbing block to obtain a sufficient dwell or closure of the contact points. The pressure required to lift this type of circuit breaker causes excessive wear on the rubbing block, and .001 wear on the rubbing block would change the contact gap .002. For example; if the contact setting was .020 and the rubbing block would wear .005, the contact point setting would be reduced to .010. This would change the engine timing perhaps as much as 10 deg. on the fly-wheel. The effect would be to retard the spark. It is for this reason that many engines appear to be lazy and use excessive gasoline when the timing of the engine is originally set from a .020 gap and the rubbing block then wears down until the gap is only .010.

In Fig. 2, it will be noticed that the rubbing block is located away

from the center of the cam. The object of this design is to overcome the disadvantages of the arrangement shown in Fig. 1; that is, to increase the dwell or closure of the contact points. This is accomplished to a certain extent because the rubbing block rides the cam for a shorter period of time. However, the advantage gained in this arrangement over what is shown in Fig. 1 is probably offset by just as many disadvantages, because the cam passes out from under the rubbing block at such an angle that it permits the circuit breaker to drop hard, causing the contact points to rebound and chatter, resulting in flashing and burning. Another disadvantage of the arrangement shown in Fig. 2 is that the cam does not lift the circuit breaker as it does in Fig. 1, because the rubbing block is set off-center, causing the cam to pull against it instead of lifting it as it should. This requires more pressure to lift the circuit breaker, which, in turn, causes back-lash, especially if an automatic governor is used.

In Fig. 3, a different arrangement is shown. The ratio between the rubbing block and contact points is one-to-one. This produces a very smooth action of the circuit breaker and contact points, because the rubbing block is located in the center of the cam and the pressure required to lift this circuit breaker is much less than the pressure required to lift the circuit breakers shown in Figs. 1 and 2. For example; if the contact pressure is 16 oz. the rubbing block pressure against the cam would be only 16 oz. Another advantage in this arrangement is that if the rubbing block should wear down .001, the gapping of the contact points would change only .001. In this arrangement, the contact flashing is less than in the other arrangements shown, due to the smooth action of circuit breakers. However, this arrangement has one big disadvantage, which is that it is impossible to obtain a long enough dwell or closure of the primary circuit. Although the one-to-one ratio circuit breaker, shown in Fig. 3, has been desirable, its disadvantage, as just explained, has retarded its use.

In Fig. 4 is another arrangement, showing the one-to-one circuit

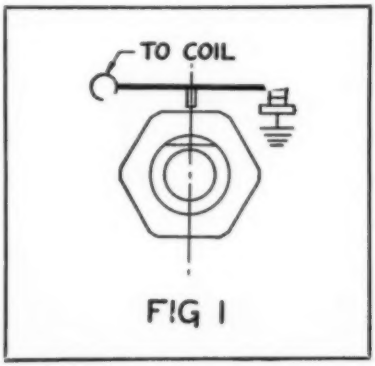


FIG 1

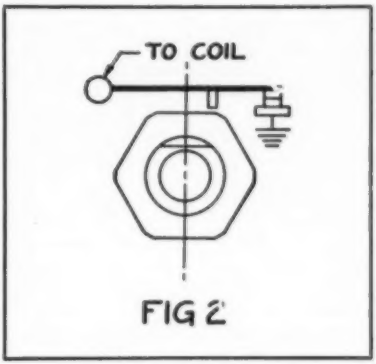


FIG 2

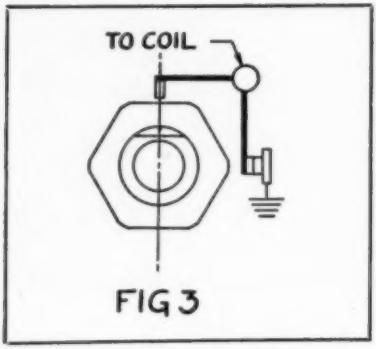


FIG 3

breaker, and, to overcome the disadvantage offered by the arrangement shown in Fig. 3, the dwell or closure of the primary circuit is increased by concaving the cam flats. This does increase the dwell, but causes rough circuit breaker action. The cam strikes the rubbing block at an angle that causes it to bounce, and the contact points drop hard, which causes them to chatter, resulting in flashing and burning of contact points. Therefore, when the cam is concaved, about the same results are obtained as would result from the arrangement shown in Fig. 2. Another disadvantage of a cam of this kind is that the pressure required to lift the rubbing block is so great that the governor action is also affected and it causes back-lash in the governor at low speeds.

The arrangement shown in Fig. 5 is not used at present. However, a similar arrangement was used in the older days. The disadvantages of such an arrangement are the same as shown in Figs. 1, 2 and 4, but are more exaggerated. A long dwell can be obtained, but the rate of speed of the contact points is almost three times as fast as the rubbing block. These contacts chatter so badly that the flashing soon destroys them. Another thing, a little wear on the rubbing block reduces the gap of the contact points and there will be excessive wear on the rubbing block in this arrangement, because the rubbing block pressure would have to be almost three times as much as the contact pressure. For example; if the contact pressure was 16 oz., which is necessary, the rubbing block pressure would be three times this or 3 lbs. This arrangement is obsolete.

To overcome some of the disadvantages referred to in Figs. 1, 2, 3, 4 and 5, some manufacturers use such an arrangement as shown in Fig. 6. In this arrangement, it is possible to increase the dwell of the contact points. A four-point cam is used for an eight-cylinder distributor, and a three-point cam is used for a six-cylinder distributor. The arrangement shown in Fig. 6 is for an eight-cylinder distributor. The rubbing blocks are located 45 deg. apart, as indicated. This causes eight interruptions of the primary circuit every revolution, which produces eight sparks from the coil every revolution. The coil is con-

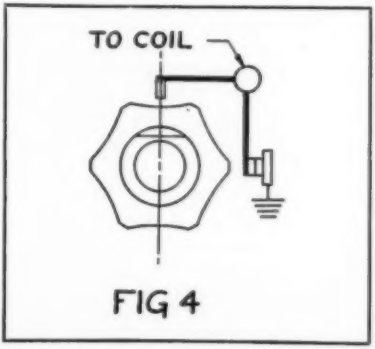


FIG 4

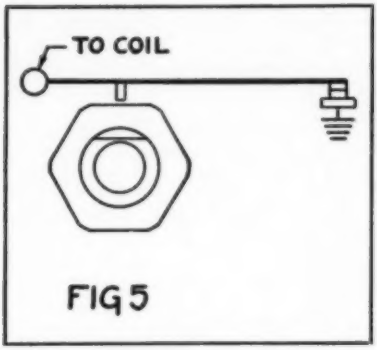


FIG 5

nected to both circuit breakers. One circuit breaker closes and breaks, firing one cylinder, and then the other circuit breaker closes and breaks, firing another cylinder.

Although this arrangement has the advantage of obtaining a long dwell of the contact points, it also has some disadvantages. For example; if one rubbing block should wear down a little more than the other, the contact points would not separate 45 deg. apart, and it would mean that the explosions in the engine would not occur at evenly timed intervals. The rubbing block wear in this arrangement is about the same as shown in Fig. 2, that is, the pressure on the rubbing block must be greater than the pressure between the contact points. In this arrangement, one set of contacts might burn down more than another, which would also affect the timing of the engine. A little wear at the pins or bushings in the circuit breaker levers would also throw the contact points out of synchronism, that is, they would not separate at even intervals.

It is understood that the arrangement shown in Fig. 6 is for an eight-cylinder distributor and that the primary circuit is interrupted every 45 deg. This means that the sparks occur in the engine every 90 deg. on the fly-wheel, because the crank shaft speed is twice the distributor speed.

The following example will prove the necessity of synchronizing the contact points shown in the arrangement at Fig. 6. Suppose one contact separates 5 deg. later than the other, then, the following action would occur: the one contact point would separate, causing the spark to occur. The other circuit breaker would open 50 deg. later upon rotation of the distributor cam, causing another spark to occur. The next spark would occur 40 deg. later. This means that the sparks would occur in the engine in this manner: One spark would occur; another spark would occur 100 deg. later; then, the next spark would occur 80 deg. later. This means uneven running of the engine, because the sparks are occurring 80 deg. and 100 deg. apart, whereas they should occur every 90 deg. The result would be that one-half of the cylin-

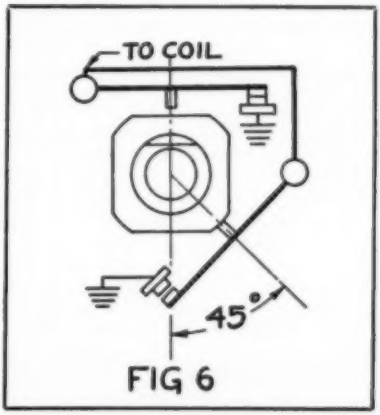


FIG 6

ders would be timed 10 deg. later than the other half.

It is impossible to adjust these contact points so that they will break at even intervals without a very accurate gauge. Even then, if the shaft bearing is a little worn, they would not break at even intervals when the engine was running. Worn contacts or variation in spacing them, worn rubbing blocks and loose bearings in the circuit breaker levers necessitate frequent delicate adjustments of such an arrangement as shown in Fig. 6.

In the arrangement shown in Fig. 7, the cam is formed to give smoother action, that is, it has more of a sliding effect under the rubbing block. This cam is designed almost opposite to the design shown in Fig. 4. In the arrangement, two circuit breakers are used, which break simultaneously or at the same time. However, in this design of cam, a long dwell of the contact points cannot be had. The rubbing block pressure required is about the same as required in the arrangement shown in Fig. 1. Although this type of cam gives smoother operation, its great disadvantage is that a little wear on the rubbing block greatly varies the timing of the engine, and a variation in the spacing of the contact points also affects the timing greatly.

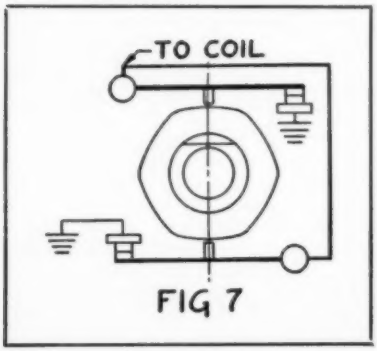


FIG 7

The size of cams is important in circuit breaker action. When a small cam is used, it is almost impossible to obtain a long enough dwell of the contact points, unless the rubbing block is offset as shown in Fig. 2. Of course, there is a disadvantage to this, as above explained.

For sake of illustration, refer to Fig. 8. This is a large cam. Above the cam, shown in Fig. 8, the length of time or distance that the rubbing block rides the cam is indicated. The cam strikes the rubbing block and lowers it, which is indicated by the two arrows spaced the longest distance apart. The rubbing block is lifted .020, as indicated by the two arrows pointing toward each other. If this was a one-to-one circuit breaker, as shown in Fig. 3, the contact points would separate .020. It will be noticed that the cam will not strike the rubbing block hard. It slides under the rubbing block more smoothly and rides down slowly, permitting the contact points to seat easily, which eliminates rebound and chattering. This action is made possible with a large cam, and it is not necessary to use a sharp pointed cam to obtain long dwell of the contact points.

When a small cam is used, the points must be sharper to obtain long contact dwell. See Fig. 10. This gives the circuit breaker only a short distance to raise and lower, which means that the contact point travel is much faster and it seats much harder, causing rebound and chattering. See illustration above Fig. 10. Notice the difference in

distance allowed the circuit breakers to raise and lower between the two cams shown in Figs. 8 and 10. In Fig. 10, the circuit breaker must lift very rapidly and close very rapidly. In Fig. 8, it lifts slowly and closes slowly.

To make the cam and circuit breaker action more clear, the following example might be used: if a car is driven over a hill 100 ft. high, the grade will be hardly noticeable if the hill is two miles long, but if the same hill had a grade of only one-half mile, the car would have to rise much more rapidly and the grade would be very apparent. The same rule applies to cams, regardless of whether they are ignition cams or other types of cams. The cam action is, therefore, of much importance in ignition, because the proper or improper running of the engine depends entirely upon the circuit breaker action.

The arrangement shown in Fig. 9 illustrates a new type of cam and circuit breakers. As above mentioned, Fig. 3 has only one disadvantage, and that is, long dwell or long closure of the primary circuit cannot be obtained. In Fig. 9, this disadvantage has been overcome. Two circuit breakers are used with a one-to-one ratio, and a longer dwell is obtained by setting one circuit breaker so that it closes in advance of the other. For example: circuit breaker "A" closes and starts the coil to build up. Later, circuit breaker "B" closes. Then, circuit breaker "A" opens, but the primary circuit is still held closed by circuit breaker "B." Circuit breaker "B" then opens, causing the spark to occur. "A" immediately closes and starts the coil to building up again.

In this arrangement, a longer dwell of the primary circuit can be

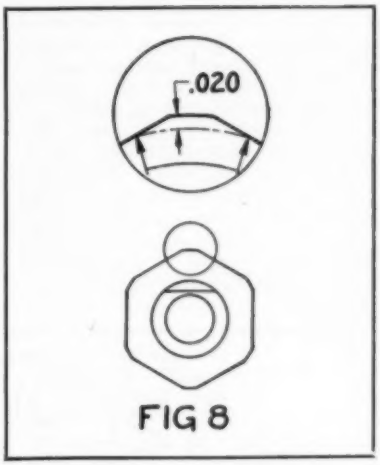


FIG 8

obtained than in any of the other types of cams shown, excepting Fig. 6, and still smoother action of the circuit breakers and contact points can be had. This arrangement has advantages over the arrangement shown in Fig. 6, because the contact "B" does all the timing of the engine, and even though one rubbing block is worn down more than the other or one contact point is breaking wider than the other, the firing balance of the engine is not destroyed. It is never necessary to use a synchronizing tool in adjusting contacts, because, with this arrangement, the explosions will always occur at evenly timed intervals, even though wear should take place on the pins of the circuit breaker levers, rubbing blocks, contact points or cam shaft, because one circuit breaker lever does all the timing of the engine.

Another advantage of this arrangement is that the dwell or closure of the primary circuit can be varied to suit any condition. One

of the circuit breakers is mounted on a movable plate, and, by shifting this circuit breaker against cam rotation, the dwell can be increased to suit any desired engine speed, regardless of whether it is a six-cylinder or an eight-cylinder engine. This design also makes it possible to use the same ignition for 12 volts as used for 6 volts. In 12-volt systems, the dwell of the contact points is decreased by moving one of the circuit breakers with cam rotation.

eliminated. This proves that the design of the circuit breaker and cam has more to do with contact flashing than the coil. Of course, flashing of contact points can be reduced by using a very low capacity coil, which produces weak sparks and unsatisfactory ignition.

Manufacturers of contact metals are constantly doing research work in an attempt to develop a contact metal that will give longer life, but it is the writer's opinon that the metal now used is suitable, provid-

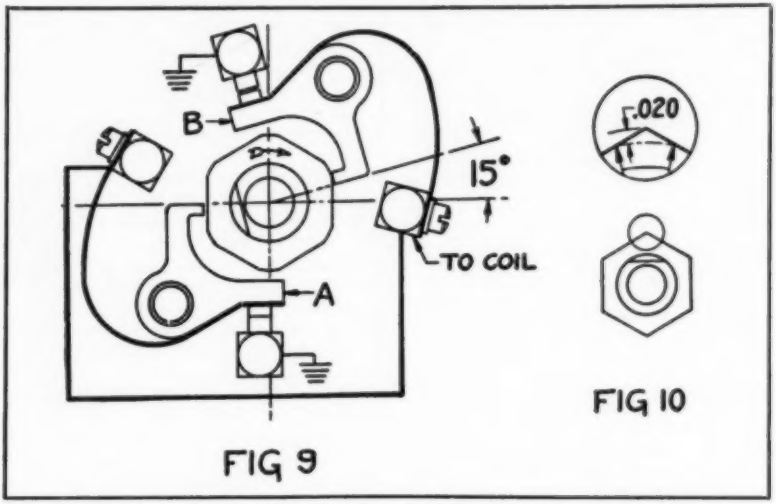


FIG 9

FIG 10

It is the opinion of many that burning of contact points is caused by the coil or condenser. This is true in one sense of the word, but in another it is not. For example: if an arrangement as shown in Figs. 4 or 5 was used, the contact flashing would be excessive, regardless of the type of coil used. If the ignitor was replaced, using an arrangement as shown in Fig. 9, excessive contact point fire would be

ing the circuit breaker and cam arrangement is such to eliminate rebound, creeping and chattering of the contacts.

Contact point trouble might be caused by two things. The chief trouble is that the flash is so bad that the metal soon burns away. Other trouble may develop if there is absolutely no flash at all between the contact points. A slight tingle or flash is sometimes desirable to

keep the surfaces burned clean. If there is not the least contact flash present, a blue coat will form over the surface of the contact points, which offers a high resistance and will interfere with starting. Such a condition as this can sometimes be overcome by the use of a lower capacity condenser. By this explanation, it will be understood that either excessive flashing or no flashing at all will cause trouble.

Excessive burning can be reduced by using a higher capacity condenser. However, there is a limit to this, because, if too much capacity is used, hard starting will be the result, because the condenser will not become fully charged from the low voltage present when starting.

There has been considerable difference in opinions in regard to hot sparks. Some contend "a spark is a spark" and that a hot spark does not have a greater effect upon the operation of the engine than one with less heat. If this were true, the design and construction of circuit breakers and cams would offer only a simple problem, if any, because coils of very low induction build up very rapidly, that is, on a very short contact dwell, and with this type of coil, it would only be necessary to use the circuit breaker arrangement shown in Fig. 3. Although in this arrangement the contact dwell is very short, it is long enough to cause a low induction or weak coil to produce more sparks per minute than required by an eight-cylinder engine. However, the sparks would not be hot enough to produce efficient combustion.

Almost any coil can be made into a high speed coil by removing some of the primary turns or reducing the amount of iron in the core, but when this is done the sparks are of lower amperage. In other words, they do not have the necessary heat even though the voltage is high. With a coil of this type, the burning and flashing of contact points is much less, and it can be easily seen that, if the hot spark was not necessary for good engine performance, engineers would not have gone to the trouble of designing cams and circuit breaker levers to cause a longer contact dwell. Also, it would not be necessary to use the arrangement shown in Fig. 6, which has disadvantages due to the synchronizing problem.

As explained, a weak coil, that is, one that will build up on a short contact dwell, will not produce sparks containing much heat, but if it is desired to use a coil that will produce sparks with high amperage, which means more heat, a coil of higher induction must be used. With this type of coil a longer time is required for it to build up, that is, the contact dwell must be longer on a coil of high induction than it is on a coil of low induction. A coil of high induction also produces more flashing of the contact points than a coil of low induction. Therefore, when using a coil of high induction, the time of contact dwell and contact flashing must be taken into consideration.

In some cases, where engines are tested on dynamometers, there may not be a great difference shown in power when using a low or a high induction coil, because the engine is generally hot and the mixture is close to an explosion point before the spark occurs, but in actual use, where the engine is running under different temperature conditions, the spark does have considerable to do with its efficient and economical operation. Many engines, especially in the winter time, do not reach a temperature high enough to operate

at their highest efficiency.

To prove that sparks have something to do with efficiency, the use and action of different types of spark plugs might be compared. For example: if so-called "cold" spark plugs are used, there will be fouling, hard starting and a drop in gas mileage, unless these plugs are placed in an engine that gets very hot. An engine that runs cold should use a plug that gets hot to assist the ignition, especially if a weak coil is used. Colder mixtures burn slower, which means lower efficiency.

It is the writer's opinion that colder spark plugs could be used with advantage if the sparks produced by the coil were hot enough, but if the coil produces only weak sparks it is advisable to use plugs that get hot. This type of plug causes more or less trouble, especially after the engine gets hot, because the plug insulator and shell will become so hot that it will cause pre-ignition, that is, the mixture will catch afire before the spark occurs. In many cases it will catch afire on the intake stroke, causing a "spit-back" through the carburetor. Another undesirable condition is the fusing of the electrodes and blistering of the insulator, thus shortening the life of the plug.

Be a Transportation Expert

THE above unusual heading in this publication has been borrowed from the Truck and Bus Tire Department of the Goodrich Rubber Company, Akron, Ohio, who is now offering an especially prepared book full of truck and bus tire facts that you can put to immediate use.

If you read this publication regularly, you are entitled to a free copy of this interesting book. We do not hold that you will learn *all* about modern transportation methods, but we feel certain that, so far as tires go, you will be a well-informed gentleman after reading the above book. The Editor is now arranging to have free copies sent; or you can write directly to the above Company. No obligation, of course, either way.

New Equipment Catalog

A HANDY reference book on garage and shop equipment has recently been issued by Manley Mfg. Company, Bridgeport, Conn.

The new catalog shows Manley items in the colors in which they are shipped and the entire book is done in these colors. Due to the fact that the Manley line is unusually large, the catalog is regarded as one of the most complete ones available. Free copies will be sent on request.

What is Viscosity?

IF you are on the lookout for proven ways to get better performance out of the motor, more power, greater mileage with a minimum of fuel and motor-wear, you are invited to send for a free booklet entitled "A Practical Test for Viscosity."

This booklet is concisely written, with a thorough knowledge of modern lubrication methods, and will be sent to you entirely without obligation. Write to the Visco-Meter Corporation, 318 Grote St., Buffalo, N. Y., or to the Editor of this publication. Your letterhead will insure prompt attention.

The Trouble Shooter

A DEPARTMENT devoted to correspondence from readers of THE FLEET OWNER. Any questions having to do with fleet maintenance will be answered. All properly signed inquiries will be replied to by mail and such of them as are believed to be of interest to other readers will be published in these columns.

Address your questions to the Trouble Shooter Editor. We must decline to reply to correspondence not signed with the writer's full name and address.

All That Foams Is Not Beer

Question: I have a 6-volt storage battery that will not take a charge, nor will it take acid successfully. When placed on the line it will froth and foam until the battery is covered. The acid showed no strength, so we replaced it with a 1.200 specific gravity solution of sulphuric acid. The results on the charging line are the same. The plates and separators seem to be in good condition. What would you recommend?—H. E. B., Thomasville, Ga.

Answer: We note you did not state whether all cells foamed, or if only one cell foamed. If only one cell foams, as we believe is the case, our guess would be that there is a small, localized short-circuit in that cell, which connects the positive with the negative plates. This might consist of a small drop of lead that has found its way into the battery, or some heavy sediment on the bottom. We know of no other condition that would cause this foaming and would suggest that you thoroughly examine this cell and take it apart if necessary.

If all cells foam while on charge, this is indeed an unusual condition and the only thing we can suggest is that you completely disassemble the battery, wash everything out thoroughly with clear water and replace the electrolyte with a 1.200 specific gravity solution of sulphuric acid.

The Crankcase Must Breathe

Question: I am having trouble with a Model A Ford truck leaking oil out through the rear main bearing. The main bearings have been renewed and have been tightened since, so I know that they are not loose. Any information as to what causes the oil to get out and down through the lower hole in the bell housing will be greatly appreciated.—G. S. H., Sadorus, Ill.

Answer: It is quite possible that the breather in your crankcase is clogged in some way, and that the blow-by past the pistons is building up excessive pressure in the crank-

case and pushing out the oil through the rear main bearing. This is the first thing you should check. In examining the oil filler or breather cap, see that it does not go down too far. We have seen several of these cars with the caps imperfect. The prongs were either bent or broken off, permitting the cap to go down too far and clogging up the opening, preventing the engine from "breathing" and causing oil to shoot out through the rear bearing.

If this is not your trouble, it is quite possible that with your new bearing the joint between the halves may not be tight and that oil is leaking out between the cap and the bearing. In the Ford design there is a rear bearing seal just forward of the flange on the crankshaft, but it is not likely to cause you any trouble. Besides, it is rather inaccessible.

Some of the Fords have a ball check valve at the bottom of the pipe that returns the oil from the rear main bearing. This prevents oil backing up into the clutch when going up a steep grade. We would suggest that you see that this pipe is not clogged up and that it is draining the oil back into the pan. If all gaskets are fitted properly, the bearings made up correctly and the breather not clogged, there should be no leak.

The Pigtail Is Loose

Question: Can you tell me what causes the ground brush spring to burn in the starting motor of a Chevrolet Truck? As soon as you step on the starter it burns. Sometimes you can crank the motor with the starter several times, but it will always burn out the spring in a short time. Thinking that the brush wire might be loose, I soldered it, but it still does the same thing.—C. Y., Mamou, La.

Answer: We believe that the pigtail wire on this brush is loose and that this causes the heavy current to flow through the spring instead of the brush. We would suggest that you raise the brush with your finger to determine whether the spring has sufficient tension to hold the brush in good contact with the commutator. Then look for loose screws which hold the pigtail wire to the head. Also note whether pigtail is loose in brush; if so, we would suggest that you install a new brush. If the spring is weak, you might also put in a new brush spring and tighten all connections securely. In replacing the brush, be sure to get the right type of starting motor brushes; and not generator brushes.

Brake Hint for Nash Cars

SOME models of Nash cars have two-shoe internal front brakes requiring a specially-tapered moulded segment. This brake is anchored at the top or operating cam and the bottoms of the shoes connected together by a hinge pin, which pin is not anchored, but allowed to float.

When relining these brakes the long taper of the segment should be riveted to the anchor end of the shoe. When brakes are then properly adjusted, this construction gives maximum lining drum contact and even distribution of pressure.

Nash cars with this type of brake should always be relined with a fully cured segment engineered for that particular brake as the taper of the segment varies with the size of the brake.—*Suggested by World Bestos Corporation.*

Wheel Bearing Trouble

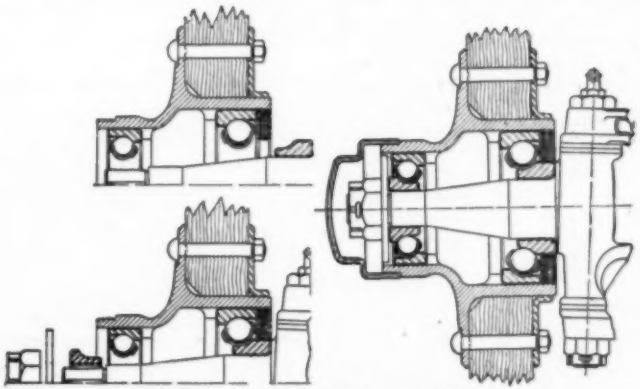
Question: Please advise what is causing frequent breaking and evident crushing of ball bearings on the inner race of the right front wheel and outer race on the left front wheel on a 1929 Chevrolet truck.—C. W. H., Toledo, Ohio.

Answer: Front wheel ball bearings, if properly mounted and lubricated, will last the life of the car, as a general rule. You may be sure that if continual trouble has been experienced on one particular car, that either the spindle is bent or the hub was bored out of line. If, however, this trouble occurs from time to time in different cars, we feel positive that it is due to improper adjustment.

It is essential that the front wheel bearings of the Chevrolet car are adjusted slightly on the tight side, rather than on the loose. If the adjustment is too loose, the failure generally shows up by destruction of the separator or cage which contains the balls, though generally in this case there is no serious deterioration of the balls themselves.

Another fault which may show up with the loose adjustment is the pounding out of the steel washer, which is placed between the inner race and spindle shoulder, it being very obvious that if all the parts are not held in position tightly, pounding action will occur at this point, which will thin out the washer and add further looseness to the bearing adjustment. The reverse of loose adjustment is excessively tight. In this case, the failure will generally show up as split or flaked balls.

In order that you may become familiar with the correct method of adjusting ball bearings, we are sending you a copy of a *Ball Bearing Service Manual.* Should any of our readers desire a free copy of this valuable book, the Editor will see that you are promptly supplied, without obligation. Ask for the *"Ball*



Steps in front wheel bearing installation

Bearing Manual." We wish to point out the fact that this is a 44-page, large size book containing a wealth of practical information on the cleaning, mounting and lubricating of ball bearings, and *not* a catalog.

How to Clean Upholstery

ORDINARY grease spots and soiling from constant use can be removed from mohair upholstery with warm water and any good laundry or toilet soap. If this operation is not sufficient, any of the reputable dry cleaning compounds are practical for the purpose but under no circumstances should any ammonia be used, as ammonia might be destructive to the color in any fabric.

Ink spots may be removed with a saturated solution of oxalic acid. Soak the stain for a few seconds with this solution, then rinse in clear water to which a few drops of ammonia have been added. Perhaps a better method, eliminating the use of ammonia, is a solution of potassium acid oxalate which is salts of lemon or salts of sorrell. Soak the stain in this solution in the proportion of two and one-half teaspoonfuls of the salts dissolved in one-half pint of water, leaving the fabric in the solution several hours if necessary, after which apply soapsuds on the spot, allowing the suds to soak well into the fiber, then rinse with cold water. This will neutralize any of the acid which may be left in the goods.

Sometimes after severe use, mohair upholstery takes a kind of set in spots, the pile being laid slightly, giving the goods a mottled color effect. This can be removed by wringing out a cloth in hot water and laying it over the parts affected. Leave the wet cloth on the mohair velvet until the cloth dries. If the velvet has not been wholly restored, repeat the operation with the result that the pile which is laid down will come back to its original position and the fabric will have its original plump appearance, not showing any signs of wear.—*Suggested by the Mohair Institute.*

How to Weld Aluminum

A NEW wall-chart has recently been issued by the Aluminum Company of America, that has been prepared to give the metal worker expert instructions for welding aluminum. It is so designed that it may be hung in the shop for ready reference. For more detailed information on the welding of aluminum, a booklet has also been issued that covers this subject fully. Interested readers can get free copies by addressing the above Company at Pittsburgh, Pa. Send your request to 2462 Oliver Building. If you desire, write to the Editor and you will be promptly supplied.

Oil Gets Into the Radiator

Question: We are having trouble with oil getting into the radiator of Model A Fords. Please let us know what causes this and how to stop it.—B. F. C., Elida, New Mexico.

Answer: We have little doubt that the oil in your cooling system comes from the water-pump grease fitting, due to excessive lubrication of this particular part and the fact that a fluid oil has been used for the same.

Our suggestion is to remove the fitting and replace it with a small grease cup, in which a good *water-*

proof grease should be used and nothing else.

It is barely possible that there is a defect in your cylinder head gasket which permits oil to seep into the water jacket and thence to the radiator, although it would seem that this leaky gasket would also permit water to enter the cylinders and stop the motor. You might take off the head and replace the gasket and also take care of the water pump as previously outlined. We would be very glad to hear from any of our readers who have suggestions to make in this connection.

An Interesting Fuel Test

A SERIES of novel tests recently completed by Graham engineers revealed an interesting fact about fuel consumption that will surprise most fleet owners. This test proves that a car going down hill at 30 miles an hour in gear, using the braking effect of the engine with throttle closed, consumes no more gasoline than when it is standing still with the engine running at its lowest idling speed.

The tests were conducted at three different speeds—325, 375, and 450 r. p. m., the engine running under its own power. After each period of idling, the engine with all the adjustments exactly the same, was driven at 1500 r. p. m. by means of an electric motor, duplicating the conditions of a car going down a hill in gear at 30 m. p. h., with closed throttle. Despite the increase in number of intake strokes per minute, the gasoline consumption remains the same, because the fuel used is in proportion to the throttle opening rather than the engine speed.

In actual fuel consumption, the engine used only one quart of gasoline an hour whether idling at 325 r. p. m. or being driven at 1500 r. p. m.

The tests were made to answer a query from a Graham owner who drives chiefly in a mountainous region. He believed he wasted much gasoline in making long descents in gear. After the tests, he was advised that he could go down hill in gear for an hour on a quart of gasoline, and that even if he should coast down in neutral, there would be no saving.

Look for Poor Ground Contact

Question: We seem to have considerable trouble with contact points, particularly on 1928 and 1929 Dodge passenger cars which use the North East System. In these cars the contact points seem to be very short-lived. Can the coils be too strong? We have replaced the condenser but this does not seem to make them last longer.—P. S., New York City.

Answer: We would suggest that you check up closely and make sure that the condenser has a good ground connection. It might be properly mounted on the distributor unit, but it is possible that there is a poor ground between the distributor and the engine.

The condenser, if in good condition, will prolong the life of contact points on any car. If the ground is poor, you will not get the full benefit of the condenser. It might be a good idea to run a separate ground wire from the condenser (ground side) to the engine block. Make sure that it is long enough so that there will be sufficient slack to allow for advancing and retarding the spark.

What YOU New Products of Interest

Speed Gears for Chevrolet

RAPIDLY increasing installations of Double Diamond mated speed ratio drive and pinion gears in Chevrolet cars is evidence of the popularity of these gears in every section of the country.

Made in a special speed ratio of 43-to-12, the new Double Diamonds give the Chevrolet a higher top

speed, and make motor speeds lower for any given road speed. In addition, they are said to bring about a very noticeable reduction in the vibration of the car, particularly at average driving speeds, and effect a worthwhile saving in gasoline consumption.

The speed ratio gears have all the features of Double Diamond mated drive and pinion gears in the standard 41-to-10 ratio. Every set is mated and lapped on heavy duty Gleason testing machines, to insure quietness and perfect tooth contact. They are wired together and tagged with instructions for correct setting, as determined by the Gleason test. Both drive gear and pinion are made of 3½% nickel steel, from upset forgings and copper plated blanks. Double Diamond mated gears are made by Automotive Gear Works, Inc., of Richmond, Indiana.

While on the subject of gears, if you have not as yet received your copy of "Modern Methods of Rear Axle Gear Installation" you are passing up a good thing. For your free copy of this practical book on gears, write to the Editor or to the Company mentioned above.

Brake Band Pliers

BRAKE specialists throughout the country will be interested in the newly introduced Kraeuter Brake Band Pliers No. 851, designed for use on internal brake springs by Kraeuter & Co., of Newark, N. J.

By removing and replacing the brake springs on the large drum quickly without disassembling, they simplify this tedious operation and save about 50 per cent on the time

WANT to KNOW

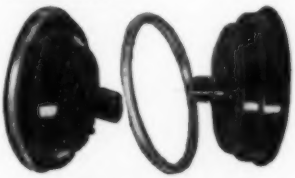
of the average relining job, the manufacturer states.

Originally designed for Ford internal brakes, they can be adjusted for use on any internal brake system using springs.

The illustration is almost self-explanatory. It shows the long hooked finger of the pliers reaching down between the two drums to release or replace the springs, while the adjustable screw rests on the top of the large drum for leverage. For complete details, write the Company mentioned above, or the Editor.

Brake Drum Bands for Fords

A NEW product is announced for the Model A Ford, consisting of reenforcement brake drum bands. Bates-Wohlert Co., Lansing, Mich., are the makers.

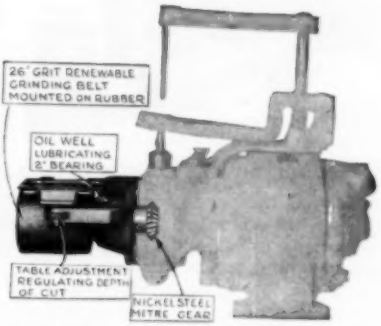


This specialty requires little or no introduction, as it is commonly known that brake drums expand and spring after the car has been in operation a short time, causing the brakes to chatter and grab.

The new line of reenforcement bands is rolled from the same high quality steel and made with the same care as the well known Bates starter gears. Installation is very simple; merely remove the wheel, heat the band and place on the drum, as shown in the illustration.

Bates brake drum bands are packed in cartons containing sets of four; twelve cartons to the crate. For further details write directly to the Company mentioned above, or to the Editor of this publication.

Brake Lining Grinding Attachment


26" GRIT RENEWABLE GRINDING BELT MOUNTED ON RUBBER
OIL WELL LUBRICATING 2" BEARING
TABLE ADJUSTMENT REGULATING DEPTH OF CUT
NICKELSTEEL METRE GEAR

THIS grinder may be easily attached to all Gem, Rayco or Raybestos Combination machines now in operation. It is the same unit as used in the large Raybestos multi-purpose machine. The illustration and captions point out the various features of this grinding attachment.

A clutch arrangement allows the grinder to remain stationary while the drill revolves. For further details, prices and catalog sheet address Raybestos-Manhattan, Inc., Bridgeport, Conn. The Editor will get this information for you, if you prefer. Ask for No. 52.

Bunting Super-Hard Bushings

BUSHINGS and bearings made of new super-hard low friction bronze alloys are announced by The Bunting Brass & Bronze Company, Toledo, Ohio, following long continued and extensive research work of the Bunting organization.

This new super-hard bronze product meets the need of mechanical industry for a bearing for applications where hardness and ability to withstand pounding are desired, together with the low friction and minimum wear assured by a leaded phosphor-bronze alloy. Such bearing requirements are especially a problem in mechanical applications subjected to shock loads, high speeds and other severe operating conditions.

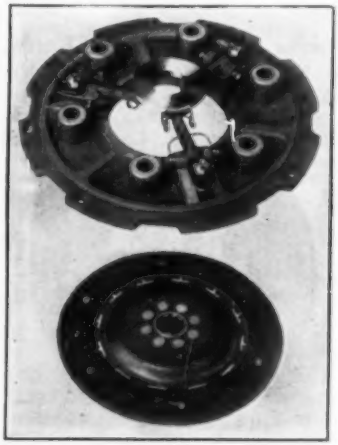
The lead content in this new bearing can be varied from 5% to 25%, depending on the type of service required. It offers physical properties superior to the higher friction bronzes containing little or no lead which have heretofore commonly been specified due to their ability to withstand heavy pressure and shock loads.

These new super-hard, leaded bronze bearings and bushings are now being supplied to many manufacturers who have long been seeking a low friction, cast bronze bearing of far greater hardness than has heretofore been obtainable.

B & B Clutch for Chevrolet

NEW in the automobile replacement parts field is the 10R model replacement clutch for six cylinder Chevrolet cars that will immediately be placed on the market by Borg & Beck Co., Chicago, a division of Borg-Warner Corp.

General construction of the clutch is similar to the ones used in higher priced cars, the manufacturer says. The clutch cover is unusually heavy to prevent warping or losing its shape. The pressure plate also is



heavy and is made of special alloy and is constructed to stand up under severe wear and extreme heat. Its thickness is uniform and permits full air circulation around the springs.

The driven plate assembly has

been specially designed of the Borg & Beck patent cushion type and has no high spots for initial contact. Both facings are in full contact during the entire period of engagement, a factor that insures uniform but longer wear, the manufacturer claims.

Battery Filling Unit

NEW in the service station field is the Lite-Way battery filling unit placed on the market by the Pines Winterfront Company, of Chicago. The chief principle of the device is to provide a handy container for distilled water and furnish a light at the end of the tube that is inserted into the battery when filling. It is especially useful for night work.

Pressure is applied to the water contents of a glass bottle by means of a rubber bulb which is squeezed to create sufficient air pressure to force the water out and into the rubber tube which is inserted into the battery when filling.

A standard flash light battery equipment is connected to the end of the hose by means of a brass apron which holds it to the tube. The brass apron extends out and beyond the small electric bulb and also acts as a reflector to spread light in the dark area where the battery is located under the seat of an automobile. On the under side of the flash light is an electric switch which controls the bulb. On the top of the apron is a small push valve which releases the water under pressure and permits it to flow quickly into the battery.

12-Battery Tungar Charger

NOW included in the line of Tungar battery chargers offered by the Merchandise Department of General Electric Company, Bridgeport, Conn., is the new 12-battery "4-in-1" Tungar charger, which is a full-wave charger with four different capacities.

Bus and truck operators will find this charger especially suited for their requirements. The charging rate control panel is an exclusive feature. Charging is regulated by positive plug in control panel, allowing closer regulation, eliminating moving parts and reducing to a minimum the wear on the control regulating parts. This panel has two independent circuits, a feature that insures efficiency on part-loads or half-loads, according to the makers. The only moving part is the snap switch.

The charger has the following capacities; 12 batteries at 6 amperes; 6 batteries at 12 to 14 amperes; 3 batteries at 12 amperes and 6 batteries at 6 amperes at the same time; 6 batteries at 6 amperes—half-load operation with full-load efficiency.

The price of this new, Tungar charger is $84.00 net, complete with two 6-ampere Tungar bulbs. Price effective East of the Rockies.

New Radio Spark Plug

A SPARK plug that improves radio reception in automobiles and motorboats and increases the efficiency of the police radio system, has been developed by Hector Rabezzana, chief spark plug engineer of AC Spark Plug Company, Flint, Mich. With the new plug, external devices are not needed to suppress interference.

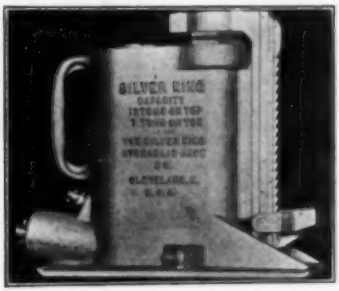
For some time the greatest problem in the use of radio in automobiles has been to eliminate interference caused by the ignition system of the engine. The regular type plugs when sparking within the engine act as small transmitting sets, and each time a spark is discharged, a clicking noise sounds in the receiver. When the motor is running at normal speed, this clicking becomes continuous and makes reception difficult. Development of the new radio spark plug is an efficient remedy for this interference and should contribute to wider use of radios in automobiles generally.

The new spark plug is already being used on radio equipped passenger cars, motorboats and by the police departments in several cities, for radio equipped scout cars and cruisers.

Screw-Type Hydraulic Jack

WHAT is said to be the only screw-type hydraulic jack having double plunger-action pump, has recently been announced by Silver King Hydraulic Jack Company, 5604 Cedar Avenue, Cleveland, Ohio.

The first model of this type is known as "Bus-12-7" and has a capacity of 12 tons on the head and 7 tons on the adjustable toe. The name "Bus" is used because the new type of jack has been designed primarily for use on buses, notable for their low overhanging bodies and unusually low axle clearance when tires are deflated.



This type of jack is claimed to be faster and easier to operate than the familiar pump type (of which Silver King makes a complete line) and all working parts are completely enclosed in a one-piece malleable body. Bus manufacturers have, according to the company, favorably commented on this new type, stating that there is a great demand for the same. Write for detailed literature and prices.

Service

HOTEL FORT SHELBY'S patronage represents a myriad of people who make the Fort Shelby their home whenever they visit Detroit. No finer tribute could be paid any hotel; it is compelling proof of Fort Shelby's ability to render the ultimate in service . . . efficiently and unobtrusively.

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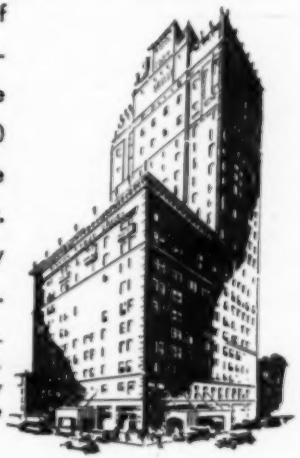

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"AGLOW WITH FRIENDLINESS"

E. J. BRADWELL, Manager

DETROIT

Maintaining 265 Motor Coaches

(Continued from page 18)

partment meets with the foremen and a review is made of every accident that has occurred during the last month. The foremen are held accountable for the safety of their men. They must explain how the accidents happen, and a discussion is held as to how to prevent their recurrence.

Our latest type of heavy wrecker for interurban motorcoach service was built from the chassis of a double-deck six-wheel motorcoach. It was designed especially for bad interurban wrecks. It has a very large cab to accommodate the wrecking crew. The long wheelbase makes it possible to lift heavy loads without danger of raising the front end. For side lifts, the rear pulley is pivoted on a hollow shaft so that the line from the winch passes through the shaft on which the boom wheel is mounted. The pulley is therefore able to turn at any angle so that, when a motorcoach or other object is to be lifted at an angle to the boom, there is no binding on the side of the pulley.

We have made it a practice to inspect every motorcoach system that we can. A comparison of inspection systems and shop practices is always valuable. Comparisons of men, or man-hours per motorcoach or per motorcoach mile, often develop interesting figures.

When one talks with the heads of motorcoach companies, they say that they are following certain methods of inspection, and do not have, or have entirely cured certain troubles. Then when one looks over their equipment, talks to their men, and looks over the scrap pile, it is apparent that they do not know their own equipment.

It is very easy for a maintenance executive to deceive himself about his inspection schedules and repair work. He may sit in his office and lay out a wonderful method of inspection, and figure out limits of wear and condemning points for his repairmen, but it is one thing to tell men to do work and another and harder thing to make sure that they do it and do it correctly. To follow the work properly, careful checking up must be carried on. Records of road calls, dead motorcoaches, gasoline and oil averages, and costs per motorcoach, all help to check the work, especially if the inspection is so segregated that the defect can be traced back to the man or gang that did the work. A personal follow-up by some supervising man is also necessary.

(EDITOR'S NOTE: *This article has been abstracted from a most thorough paper on Motor Coach Maintenance prepared by Mr. See and read before the Transportation Meeting of the Society of Automotive Engineers held at Pittsburgh, Pa., some time ago. In our March issue of this year our first abstract was presented. Acknowledgement is again made to both Mr. See and the Society, for their splendid cooperation in making the publication of these articles possible.*)

Coordinating Freight Service

(Continued from page 26)

The traffic is also returned to the railroad at attractive rates.

The pick-up and delivery service is performed in one of two ways, depending upon the volume to be transported. For large shipments a container is supplied for direct loading and it is picked up by truck and interchanged to rails at the rail head. If the volume offered by one shipper is comparatively small, it may be collected by small trucks, taken to a consolidation point, loaded into a container and moved by a heavy truck to the rail head where transfer is made to rail car. This operation is reversed at destination.

When the container is lowered by crane on the flat car, special anchorage devices automatically lock all of the four doors so that pilferage is impossible. In addition, padlocks or seals can be placed on the doors to give protection while the body is being transported by truck. Cargo Transport is responsible for all loss and damage claims except those caused by damage to the container and contents by wreck or accident while in the custody of the railroad.

The container is 17 ft. 6 in. long, 8 ft. wide and 7 ft. 6 in. high. It is constructed entirely of steel, except the floor which is of wood, and has four steel lift hooks located near the four corners to prevent tipping while the body is being lifted by the gantry crane. Four doors are provided, one on each side and end, made waterproof to prevent damage to in-transit shipments. When the doors are opened to a 90-degree angle they can be lifted off the hinge pins, an advantage under certain loading conditions. Anchorage devices mounted on the floor of the flat car and the motor truck, center and securely hold the body from shifting. The body frame cross members are spaced to provide wheel pockets, thereby permitting a lower mounting of the body on the truck chassis. This feature permits larger loading space without exceeding the legal over-all height limitations of the truck.

Over-night service is given between Toledo, Dayton and Cincinnati and second-morning delivery to Michigan and Kentucky cities. Each body is covered by insurance to the extent of $20,000 or more if required by the shipper.

The rates charged by Cargo Transport, Inc., include store-door pickup and delivery within the corporate limit of the cities indicated in the table.

Rear End Servicing

(Continued from page 32)

coast or reverse bearing will result.

(EDITOR'S NOTE: *Should any readers have further problems on rear axle gear work that may not have been covered in these two articles, we will be glad to discuss them through the medium of our Trouble Shooters' Department. Requests for the book, "Modern Methods of Drive Gear Installation" will be promptly attended to. This is a 32-page book containing a complete treatise on the subject. Free copies are still available. Write to the Editor, or to Automotive Gear Works, Richmond, Indiana.)*

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Bus and Truck Impacts

(*Continued from page 36*)

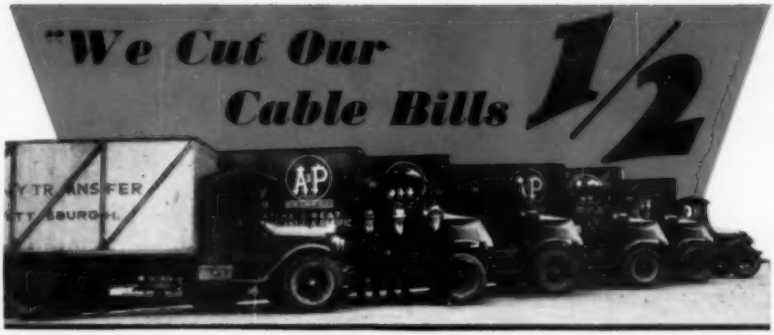
making for ten years or more. The earlier studies dealt with the measurement of impacts caused by heavily loaded motor trucks, especially those with poor tire equipment.

The recent studies were conducted on a concrete road at Aberdeen (Maryland) Proving Ground, through the courtesy of the Ordnance Department. The vehicle used was a modern high-speed bus chassis with a special body. The floor of the body was divided into small compartments for retaining 100-pound cast-iron weights used to vary the loads.

The tire equipment included both high-pressure pneumatic and balloon types, and the range in size was from 7-inch high-pressure to 12-inch balloon. Inflation varied from 53 to 107 pounds per square inch. Rims were of 20 and 24-inch diameter.

The tests involved two types of obstruction, each 1½ inches high; one an inclined plane 30 inches long, and the other a rectangular obstruction 12 inches wide.

The magnitude of the impacts was measured by a multiple-element contact accelerometer, consisting of ten sensitive elements, which was designed and built by the bureau as a modification of a single element instrument used in earlier impact tests. The accelerometer was mounted on the rear axle of the bus, and was in a position to respond to any vertical accelerations imparted to the axle by the wheel.



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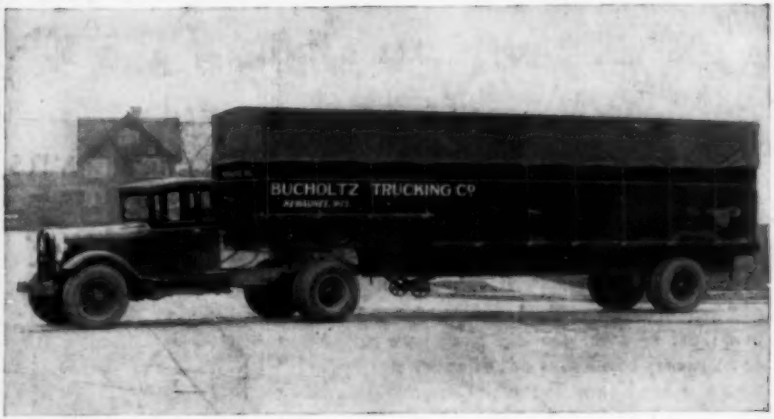

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